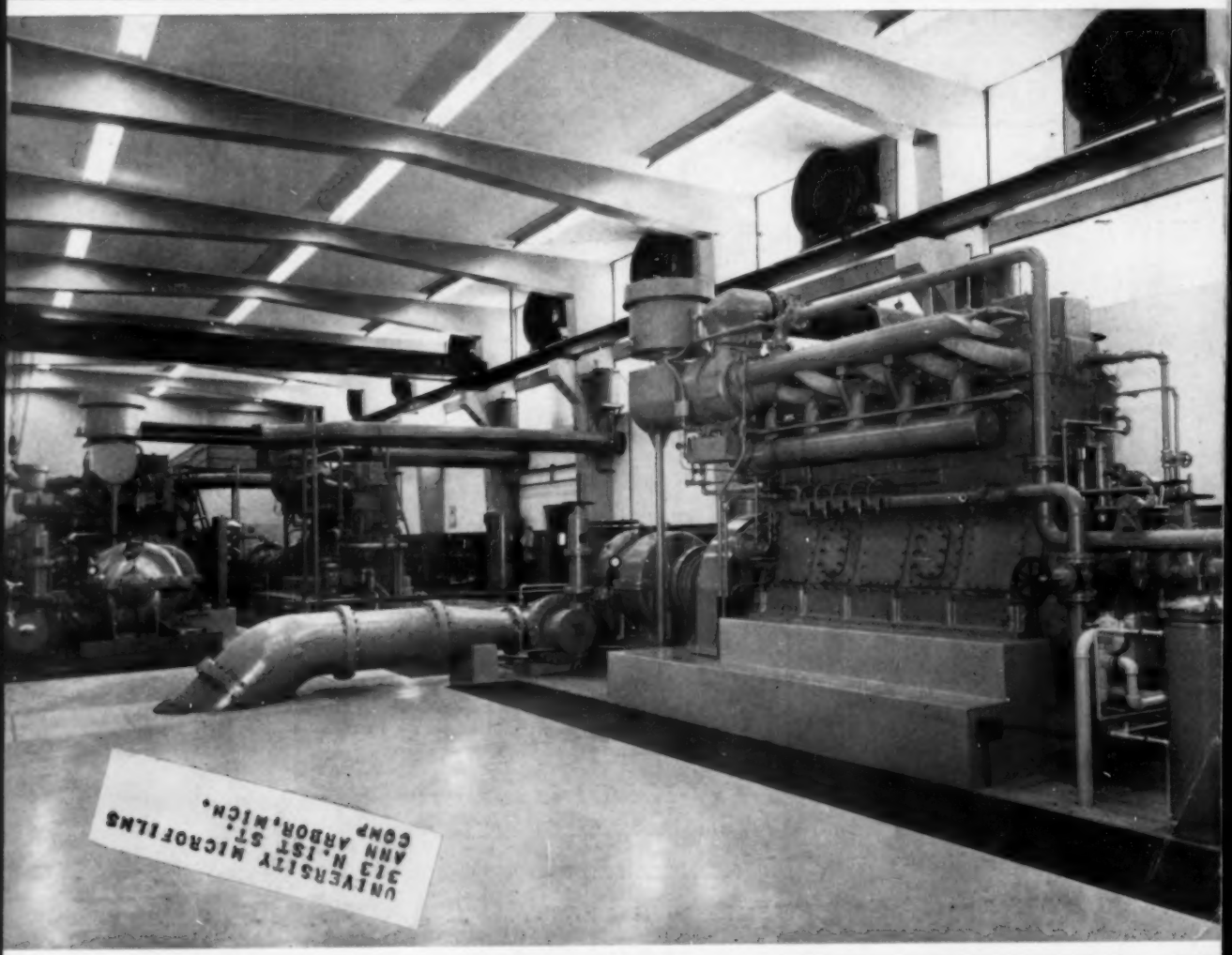
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL



UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP

AUGUST 1956

Miami's All-Diesel Hurricane Proof Pumping Station (Pages 331-333)

Industrial Waste Ordinances—Methods of Application (Pages 368-371)

Courting New Industry? . . What Of Water Supply & Pollution? (Pages 342-346)

Superior Performance

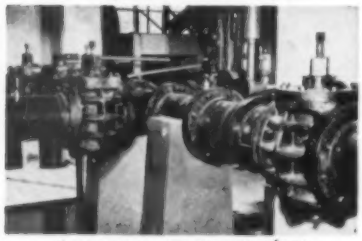
by all acf Lubricated Plug Valves

THIS TEFLON GASKET PREVENTS HEAD LEAKAGE— REDUCES TURNING TORQUE

* Gasket Characteristics

. . . Self lubricating
. . . Can't bind
. . . Unique shape maintains lubricant release
. . . Pressure tight.

On circulating water pumps in petroleum industry.



In sewage treatment plant.

Gas measuring station installation.

This Teflon* Gasket is another example why acf lubricated plug valves are your best buy in round or rectangular port valves.

It not only gives greater protection against head leakage, greatly reduces turning torque, and operates in temperature to 450°F, but it also prolongs service life . . . and that means a substantial saving in valve maintenance costs.

Many years of field testing, plus years of industry service, have proved the importance of this feature in acf valve performance. See your acf Representative and learn why it pays to specify acf valves.

* DUPONT TRADE NAME

5602

W-K-M Manufacturing Company, Inc.

A SUBSIDIARY OF acf INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS • MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURING

W-K-M THROUGH-CONDUIT GATE VALVES

acf LUBRICATED PLUG VALVES

KEY RETURN BENDS AND FITTINGS

In Current Salt Lake City Project

CLAY PIPE PROTECTS PUBLIC HEALTH

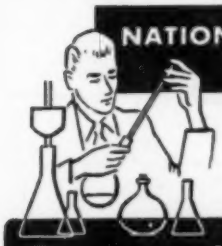
THE SALT LAKE CITY SUBURBAN SANITARY DISTRICT is expanding its sewerage program with bond-financed projects totalling $8,890,000 and requiring thousands of feet of Vitrified Clay Pipe. The men who design and build basic public health facilities like these rely on Clay Pipe for its unmatched dependability. Engineers planning the Salt Lake installation specified Clay Pipe for its "permanence and low cost."

Clay Pipe is completely unaffected by strong detergents, sewer gases, acids generated by sewage, and industrial wastes. It's chemically inert, so it never wears out. Wherever public health is at stake, it pays to insist on the *longest-lasting* sewer pipe. Always specify Vitrified Clay Pipe, in the new longer, stronger sections, developed through the Clay Pipe Industry's new research program. Clay Pipe is backed by a *guarantee no other pipe matches.*

Officials directing the Salt Lake project include: District Trustees; A. F. Stewart, L. B. Gunderson, and R. P. Greenwood. *Consulting Engineers;* Caldwell, Richards & Sorenson.

Vitrified CLAY PIPE

CLAY PIPE NEVER WEARS OUT!



NATIONAL CLAY PIPE MANUFACTURERS, INC.
1820 N. Street, N.W., Washington 6, D. C.

206 Connally Bldg., Atlanta 3, Ga.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

C-256-11

Progress in Public Health - Through Clay Pipe Research

Tough Problem Solved

F&P Engineering solves Meyersville's problem: Higher fire insurance rates or safe water.

If all the property owners in Meyersville, Maryland were to avoid an increase in fire insurance rates, the main water pressure, during fire emergency, had to be maintained above the allowable minimum.

All other automatic proportioning Chlorinator systems recommended to Meyersville required permanent head losses far in excess of the allowable minimum or were prohibitively expensive.

All, that is, except the F&P Chlorinator. F&P, applying its wide instrumentation and systems engineering experience, utilized standard components to solve Meyersville's problem.

Since its installation the F&P unit has given accurate, maintenance-free, money-saving service.

If you have *any kind* of chlorination problem, why don't you call Fischer & Porter now? Write or call today—without obligation—for complete information and engineering data.

FP **FISCHER & PORTER**

186 FISCHER ROAD, HATBORO, PA.

IN CANADA:
FISCHER & PORTER (CANADA) LTD.
TORONTO 15, ONTARIO

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

COMING ARTICLES

Landmark Filtration Plant Sets a Pattern in Unusual Design ....*Johnson*
Legal Aspects of Fluoridation .....*Murdoch*
Philadelphia's Incentive Pay Plan Boosts Meter Shop Output ....*Arnold*
Water Reclamation From Sewage as a Conservation Measure .....*Rawn*
Operation and Maintenance of Water Distribution Systems .....*Miller*
Experiences With the Micro-Strainer in Sewage Treatment .....*Evans*
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Ways of Cutting Operating Costs at Water Treatment Plants .....*Hirsh*
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The C.M. McCord Pumping Station is Memphis' Newest .....*Filby*

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WATER AND SEWAGE WORKS is published monthly with an extra issue in June. Subscriptions including the Reference and Data issue in the U.S. and Canada, 1 year $3.00; 2 years $4.50; 3 years $6.00. Other countries $1.50 per year additional. Single copies 25c except Reference and Data issue 50c.

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the big

NO ONE KNOWS America's water problem better than you.

With water consumption today four times greater than fifty years ago . . . and mounting daily . . . your responsibilities are heavier than ever.

Many of you not only must find new sources of water but new ways to conserve your present supply. This calls for the cooperation of an informed and alert public, conscious of your problem and mentally conditioned to help you solve it.

MODERNIZED **cast iron**

squeeze is on!

Here, we can and will continue to help.

Our national campaign, reaching millions, stresses the increasing need for industry and homeowner alike to use water wisely and plan in advance for adequate water facilities. It urges realistic water rates and asks support for the forward-looking legislation and bond issues that will insure a plentiful supply for the future.

It's designed to help America conserve its most precious national resource . . . and keep water flowing, freely and abundantly, for all.

CAST IRON . . . the pipe that's bought on proof, not claims

No other pipe can point to so convincing a record of long life.

For over 70 public utilities in America, cast iron mains laid over a century ago are still giving satisfactory service. This demonstrated record of long life (made in the ground, not printed claims) not only gives the public the dependability it has a right to expect in a water system . . . it saves tax dollars as well. Once in the ground, cast iron serves for generations with minimum maintenance. Cast iron's long term economy pays off!

Today, water officials can rely on even better cast iron pipe. Modernized cast iron, centrifugally cast to be even tougher, stronger, more uniform. And where needed and specified, lined with cement mortar to assure sustained carrying capacity throughout its long service.

You specify wisely and well when you specify cast iron pipe for your water system. The experience of centuries proves you chose the best.

Cast Iron Pipe Research Association, Thomas F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.

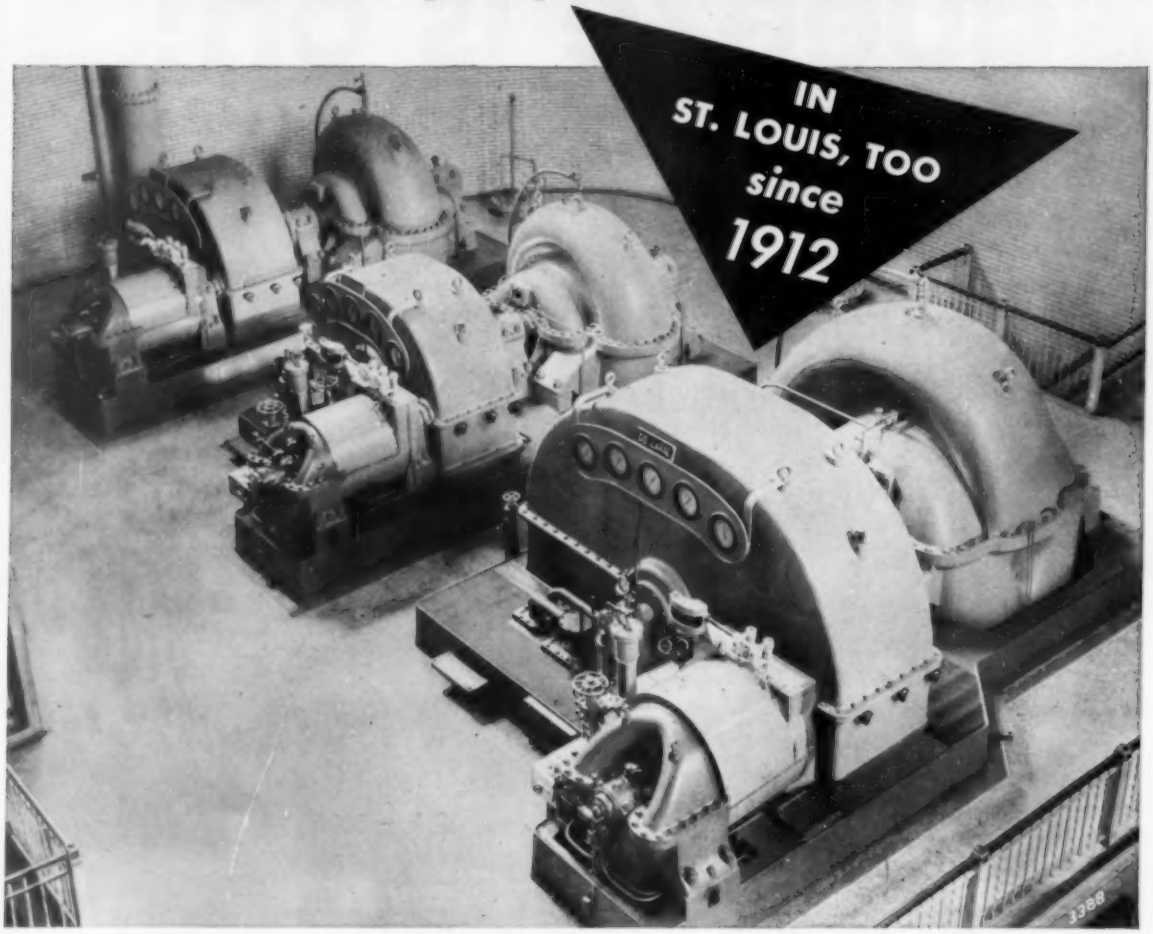
This gallant old cast iron water main laid in 1850 is still serving and saving tax dollars for the citizens of Buffalo, N. Y.

CAST Q IRON®

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS

DE LAVAL pumps America's water...



The three De Laval turbine-driven centrifugal pumps (shown above) have given dependable service in the Howard Bend Station of the St. Louis, Mo. water works system for more than a quarter of a century. The two smaller units have a capacity of 60 mgd and the larger one of 120 mgd, all designed to deliver against 40 ft. head.

In the St. Louis Chain of Rocks Station, De Laval pumps have an even longer service record. Two 40 mgd units were installed in 1912 and a 100 mgd unit in 1918. Two of these three pumps are still on the line. The third has been altered and is still in constant service.

For St. Louis' expanding needs, De Laval is now building ten more centrifugal pumps with a total capacity of 450 million gallons per day.

Write for your copy of new De Laval Bulletin 1004

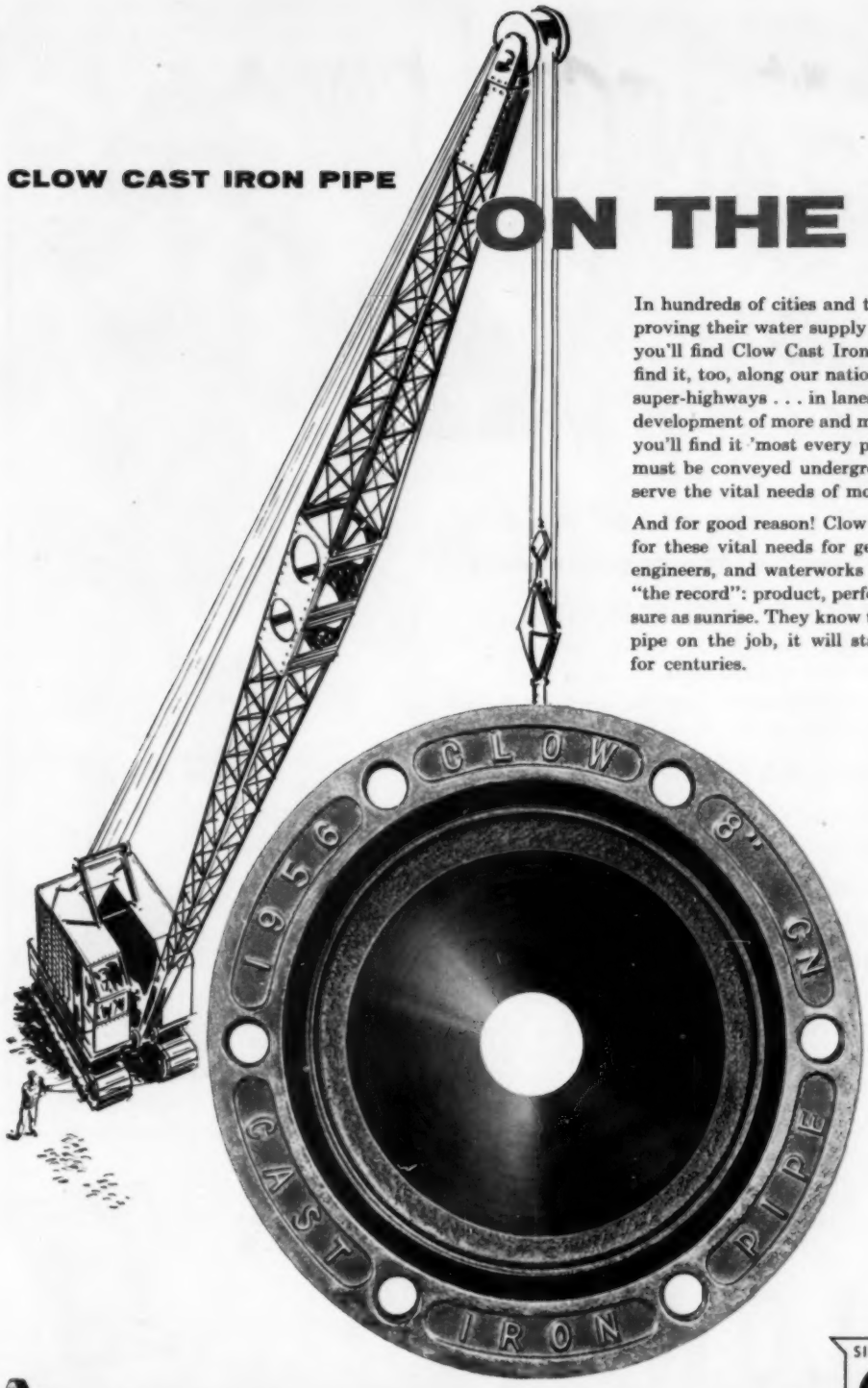
DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
824 Nottingham Way, Trenton 2, New Jersey

DL 356

CLOW CAST IRON PIPE

ON THE JOB



In hundreds of cities and towns expanding and improving their water supply and distribution service, you'll find Clow Cast Iron Pipe on the job. You'll find it, too, along our nation's newest toll roads and super-highways . . . in lanes and by-ways . . . in the development of more and more communities. In fact you'll find it 'most every place . . . wherever water must be conveyed underground, under pressure, to serve the vital needs of modern life.

And for good reason! Clow has been supplying pipe for these vital needs for generations. City officials, engineers, and waterworks men like what they call "the record": product, performance-proved; service, sure as sunrise. They know that when they put Clow pipe on the job, it will stay on the job—to serve for centuries.

SINCE 1878

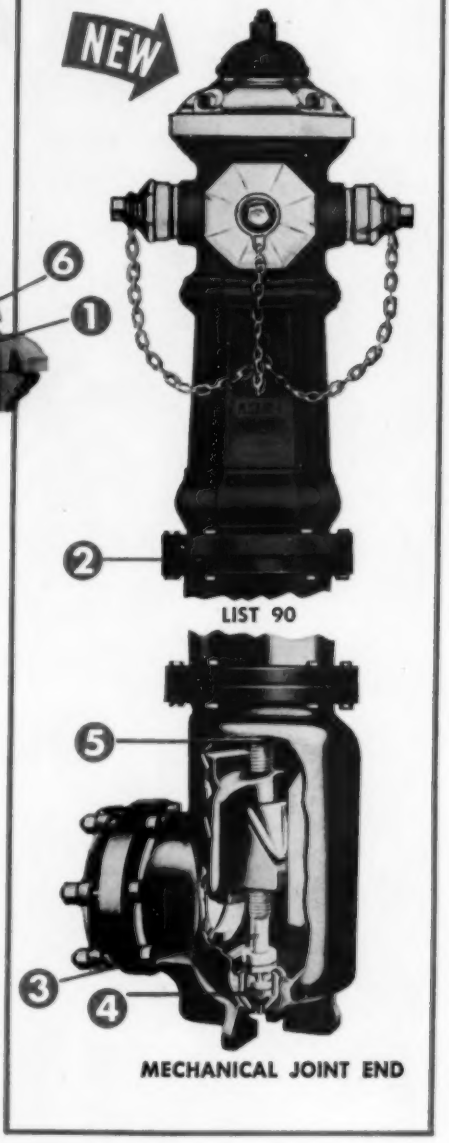
JAMES B. CLOW & SONS, Inc.

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, New York
Iowa Valve Company, Oskaloosa, Iowa

A. W. W. A. HYDRANTS

EASY TO OPERATE AND MAINTAIN



Ludlow hydrants incorporate all the advantages and meet all the requirements for safety, durability and economy.

HERE'S WHY:

1. **POP-OFF SLEEVE COUPLING:** releases hydrant head from stem in event of traffic damage.
2. **BREAKABLE GROUND LINE FLANGE** eliminates digging.
3. **NO FLOODING.** Closed hydrant remains locked—even in event of traffic accident.
4. **NO FREEZING.** Positive drip action, at extreme bottom, assures complete drainage.
5. **90,000 TENSILE STRENGTH** rolled Everdur threaded stem section completely eliminates stem failure.
6. **LESS OPERATING TORQUE.** New, non-binding upper and lower "O" rings trap lubricant . . . assure positive water tight seal . . . require no servicing.

THE RESULT: LOW INITIAL COST—YEAR AFTER YEAR—OF TROUBLE-FREE SERVICE.

"NO POSSIBLE DIFFERENCE IN FIRST COST CAN OVERBALANCE THE PERPETUAL ECONOMY OF QUALITY."

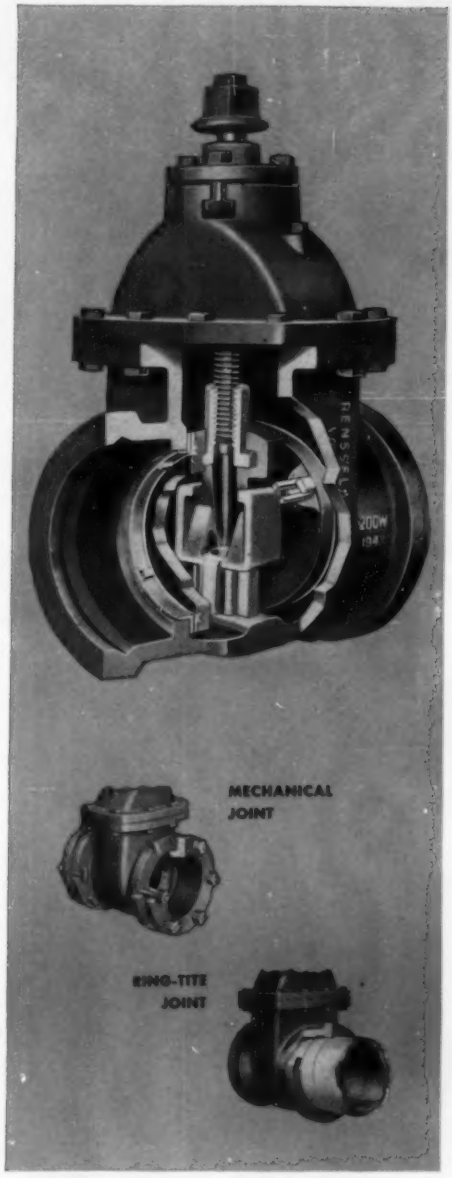
13

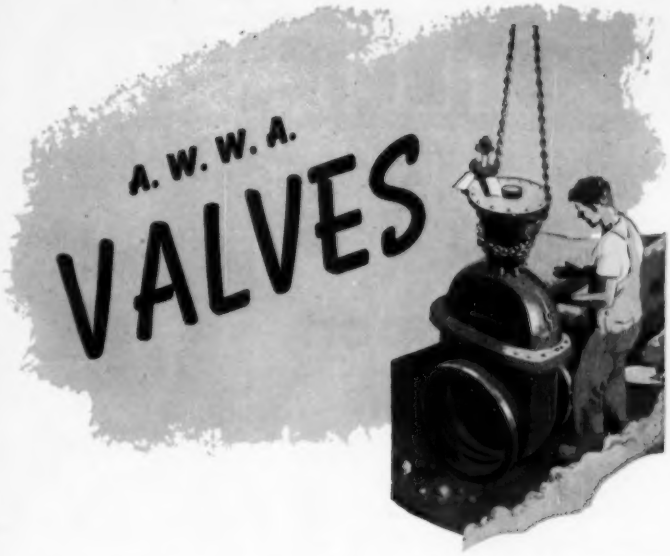
Ask for Bulletin 54-H

THE LUDLOW VALVE MFG. CO., INC. TROY, N.Y.

TRADE LUDLOW MARK

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES
CHECK VALVES • TAPPING SLEEVES • AIR RELEASE VALVES





It costs more to dig up a valve than it does to be sure that the valve is right in the first place. Rensselaer A.W.W.A. Valves have been giving satisfactory service in hundreds of cities for many years, and there are many "reasons why."

The well known Rensselaer wedge mechanism, for instance, presses the gates firmly against the valve seats on closing, but on the first turn of the opening, the wedging mechanism is released and the gates are free.

The generous use of solid bronze, the rust proofing and the simplicity of servicing make for long life and low maintenance. All parts are interchangeable and accurate because of the precision casting and machining.

Only two types of valve ends are shown. All types are available together with tapping valves and other accessories.

The names, Ludlow and Rensselaer mean the same today that they have during your lifetime. The desire to serve the Water Works Field in person—in research and design and in prompt delivery of original equipment and spare parts for all products has not changed. On the other hand, our ability to serve has at least doubled.

16

Ask for Bulletin "A"

Rensselaer VALVE CO.

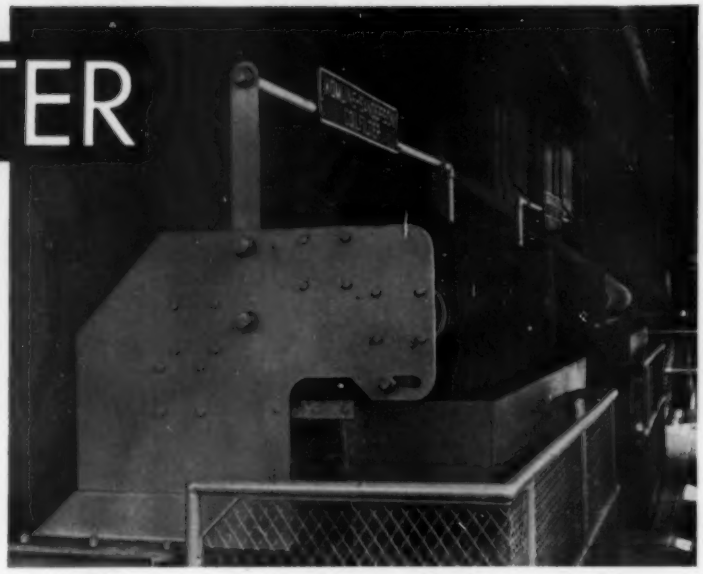
TROY, NEW YORK

DIVISION OF THE LUDLOW VALVE MANUFACTURING CO., INC.

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES
CHECK VALVES • TAPPING SLEEVES • AIR RELEASE VALVES

COILFILTER

versatility . . . at Williamsport, Penna.



West Plant: Design conditions; Domestic population 10,000. Average Daily Flow 0.8 MGD. Maximum Daily Flow 1.6 MGD. Two 150 Sq. Ft. COILFILTERS.

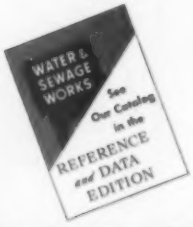
COILFILTER versatility is demonstrated at the two Williamsport, Pennsylvania, sewage treatment plants, where a total of four COILFILTER units are successfully dewatering sludge of widely divergent characteristics.

The West Plant dewaters a daily average of 9300 pounds of raw sludge, of which 85% to 90% is waste tannery solids, using two 150 Sq. Ft. Coilfilters. The product is then incinerated.

The Central Plant is a primary treatment plant with digestion and elutriation of the sludge prior to dewatering on two 100 Sq. Ft. COILFILTERS. The product is either dried or incinerated.

Central Plant: Design Conditions; Population 60,000. Average Daily Flow 5.15 MGD. Maximum Daily Flow 10 MGD. Two 100 Sq. Ft. COILFILTERS.

Engineers:
The Chester Engineers
Pittsburgh, Penna.



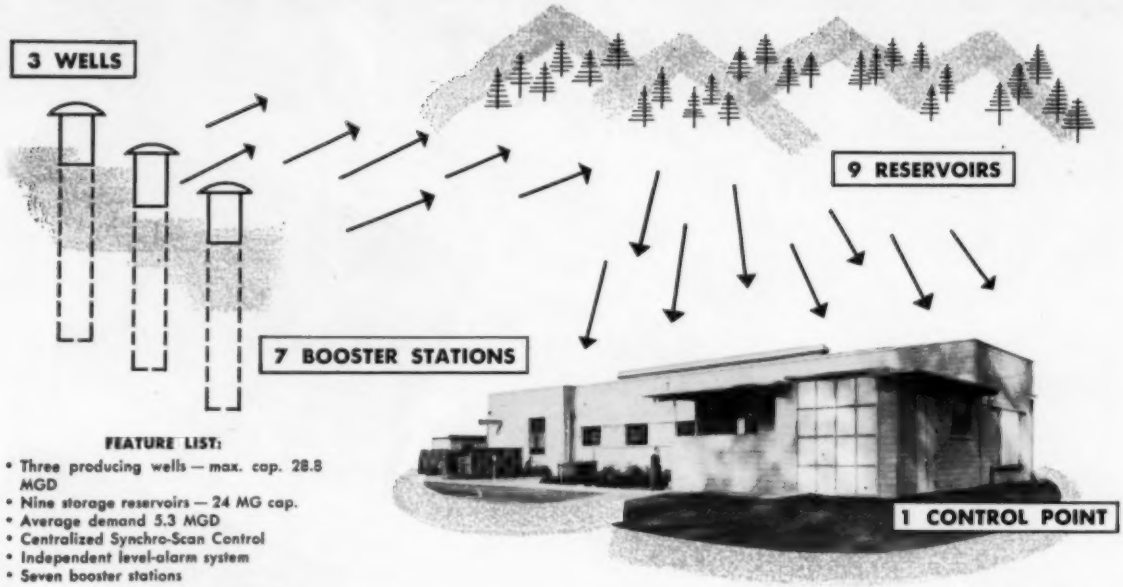
Write for Bulletin No. 104

Representatives throughout the U. S. A.

KOMLINE-SANDERSON ENGINEERING CORPORATION
Peapack, New Jersey

MANUFACTURERS OF COILFILTER SLUDGE VACUUM FILTERS

WHITTIER CALLS IT Water-AUTOMATION



FEATURE LIST:

- Three producing wells — max. cap. 28.8 MGD
- Nine storage reservoirs — 24 MG cap.
- Average demand 5.3 MGD
- Centralized Synchro-Scan Control
- Independent level-alarm system
- Seven booster stations

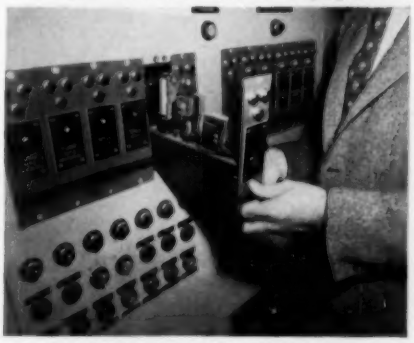
Schematic Sketch — "Water-mation" in Whittier

WE CALL IT Synchro-Scan SUPERVISORY CONTROL!

This installation in Whittier, California is a typical example of the supervisory control systems (Water-mation) that Builders-Providence has been furnishing municipalities for years. Installed in conformance with specifications of the consulting engineering firm of Koebig and Koebig in Los Angeles, the Whittier system provides centralized control of the three wells, nine reservoirs, and seven booster stations which furnish the city's water supply. Special provision is made for chart recording and automatic alarm system in the Water Superintendent's office at City Hall.

Builders-Providence Synchro-Scan Supervisory Control, by permitting an unlimited number of control or advisory functions to be performed from a centralized control panel, reduces operating costs of widely-spread systems. All supervised units (pumps, valves, etc.) have individual, interchangeable, "plug-in" components on the master panel which, through transmission over leased telephone circuits (or other means of transmission) offer versatile performance and outstanding dependability over long distances. Bulletin 240-M6 gives full details on this economical, multi-function control system. Address requests to **Builders-Providence, Inc., 350 Harris Avenue, Providence, R. I., . . .** division of

Master Control Panel — Whittier Pumping Plant



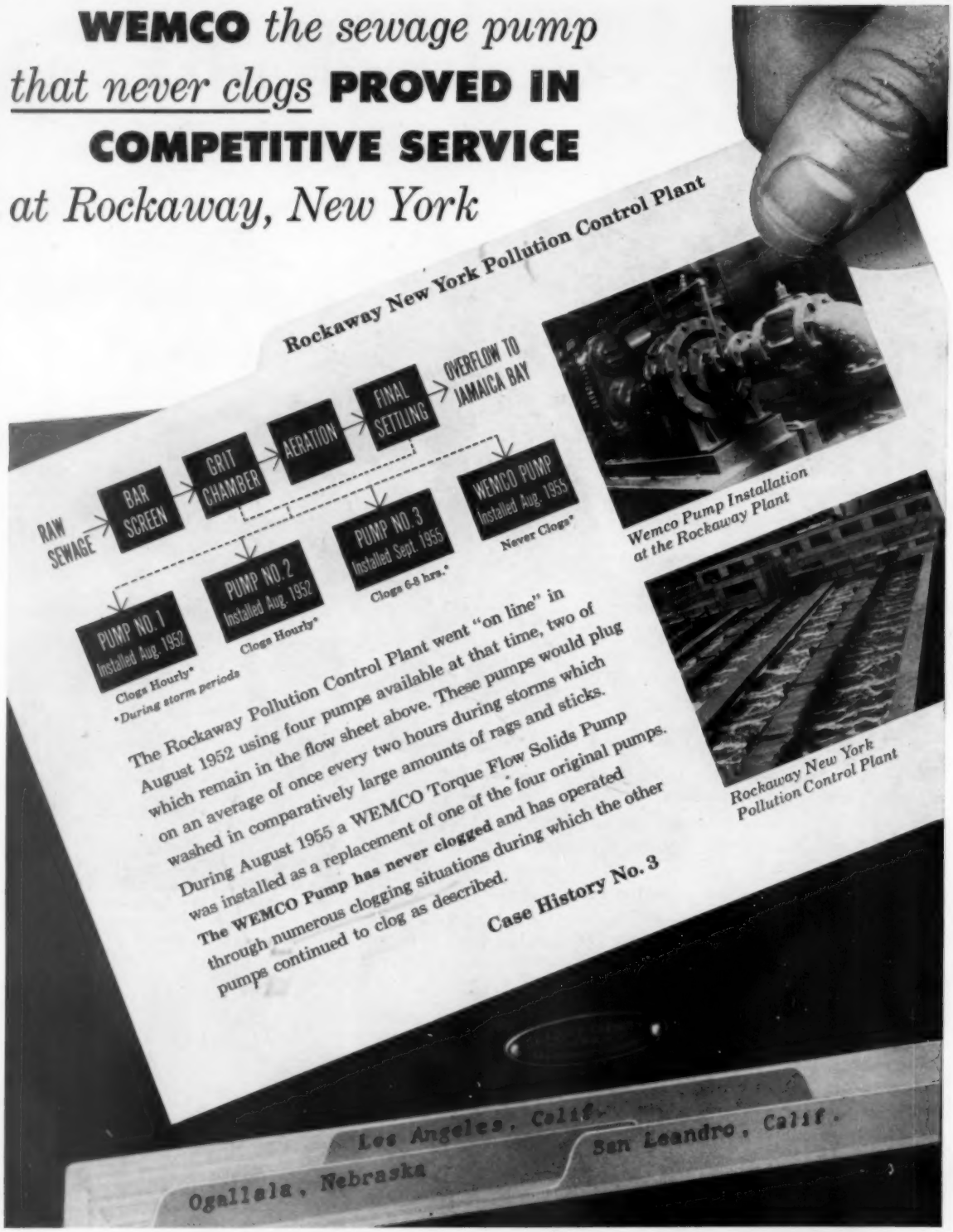
Close-up of "Plug-In" Component

B-I-F INDUSTRIES
PROVIDENCE, RHODE ISLAND

BIF METERS FEEDERS CONTROLS

BUILDERS-PROVIDENCE, INC. • OMEGA MACHINE CO. • PROPORTIONEERS, INC.

WEMCO *the sewage pump that never clogs* **PROVED IN COMPETITIVE SERVICE** *at Rockaway, New York*


Rockaway New York Pollution Control Plant
RAW SEWAGE
BAR SCREEN
GRIT CHAMBER
AERATION
FINAL SETTLING
OVERFLOW TO JAMAICA BAY
PUMP NO. 1 Installed Aug. 1952
Clogs Hourly*
PUMP NO. 2 Installed Aug. 1952
Clogs Hourly*
PUMP NO. 3 Installed Sept. 1955
Clogs 6-8 hrs.*
WEMCO PUMP Installed Aug. 1955
Never Clogs*
*During storm periods
Wemco Pump Installation at the Rockaway Plant
Rockaway New York Pollution Control Plant
The Rockaway Pollution Control Plant went "on line" in August 1952 using four pumps available at that time, two of which remain in the flow sheet above. These pumps would plug on an average of once every two hours during storms which washed in comparatively large amounts of rags and sticks. During August 1955 a WEMCO Torque Flow Solids Pump was installed as a replacement of one of the four original pumps. **The WEMCO Pump has never clogged** and has operated through numerous clogging situations during which the other pumps continued to clog as described.
Case History No. 3
Los Angeles, Calif.
San Leandro, Calif.
Ogallala, Nebraska

Wemco's unique torque-flow design has been responsible for many outstanding "never clog" records. The principle is fully explained in available literature. It will save you thousands of dollars in operating costs. Write today for your copy.

WEMCO
WESTERN MACHINERY COMPANY

762-L Folsom St. • San Francisco 7, Calif. • Representatives in principal cities of the United States and Canada and in major countries throughout the world

MUELLER®

ABSOLUTE CURB CONTROL

■ Inverted key design with steep key taper is your assurance of positive water control at the curb. The Mueller Inverted Key Curb Stop has a much steeper than average key taper – a light tap on the shut-off rod unseats the key, allowing easy turning, regardless of long periods of disuse.

■ Stop bodies and keys are precision ground and individually lapped together, assuring you of a watertight fit around the ports. Added insurance against leakage is attained by using inlet water pressure to exert an upward thrust against the bottom of the inverted key, seating the key solidly in the body. As inlet pressure is increased, upward thrust against the key is increased.

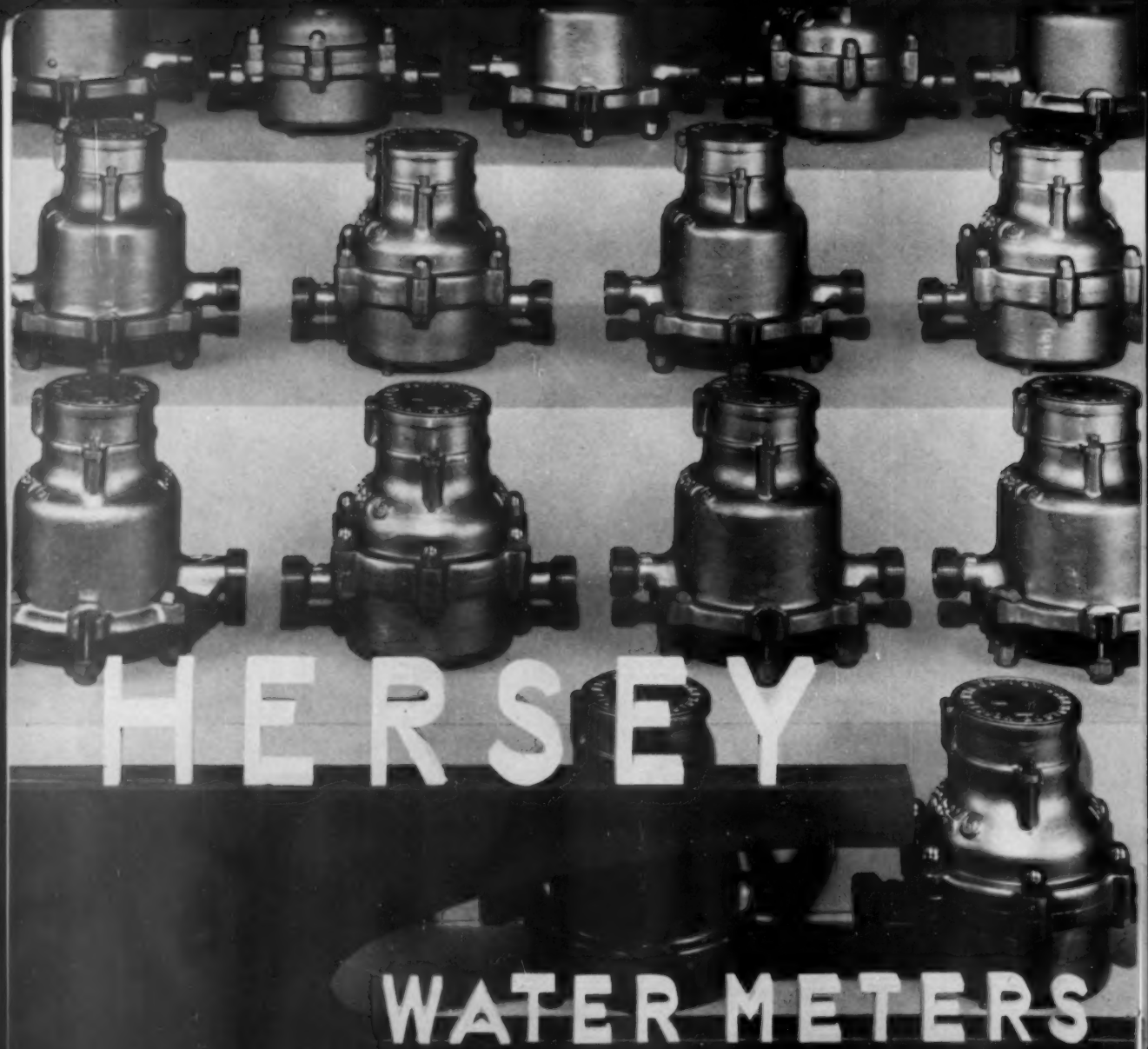
■ Iron pipe, copper, lead flange and wiped joint inlets and outlets may be used in various combinations to meet your specific requirements. Stops may also be ordered in Minneapolis pattern.

Ask your Mueller Representative, or write direct, for more information on the inverted key and other Mueller Curb Stops. A wide choice of solid tee head curb stops with various combinations is also available.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS



The constantly increasing demand for

HERSEY WATER METERS

clearly demonstrates that they meet the exacting requirements of experienced water works engineers who are primarily interested in low maintenance costs and trouble free accurate registration.

It's the life of a meter that counts — not the cost.

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

More Than 350,000,000 Gallons of Water Per Month

"The Finest Water in the South" —that's what Pensacola, Florida, says about its water supply. This rapidly expanding city, blessed by Mother Nature with ideal climate, snow-white beaches and the beauty of the Gulf of Mexico, realized the vital importance of plenty of good water and selected Layne to develop its ground water resources. Pensacola relies on Layne equipment to provide upwards of 350 million gallons of water a month.

Municipalities, large and small, join industry and agriculture in endorsing Layne—the world's largest developers of ground water resources.

LAYNE
& BOWLER, INC.
MEMPHIS
General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Layne

Water Wells · Vertical Turbine Pumps · Water Treatment

HEADS OR TAILS

you win

WITH CHAPMAN *Standard* SLUICE GATES

How can you lose? Chapman Standard Sluice Gates are on your side *at all times.*

You win before you use them. Installation is faster and simpler. Because such component parts as discs, guides, hooks and wedges are standardized, every fit is made quickly without match-marking or alterations in the field.

Even after you use them, you win. If the time comes, the standardized parts . . . the result of Chapman standardized manufacturing . . . are easy to replace and are fitted without alterations. Your maintenance costs go down.

To win both ways . . . specify Chapman Standard Sluice Gates. All of them . . . with manual, hydraulic or electric motor control . . . in an extra large variety of sizes and designs are explained in full in our Catalog 25. Write for your free copy, today.

THE CHAPMAN VALVE MFG. COMPANY
Indian Orchard
Massachusetts

By changing the character of hormones and genes science may increase tremendously the size of fowl and domestic animals . . . put more meat at less cost on the American table.

100 years from now...

WE MAY RAISE CHICKENS AS BIG AS OSTRICHES!

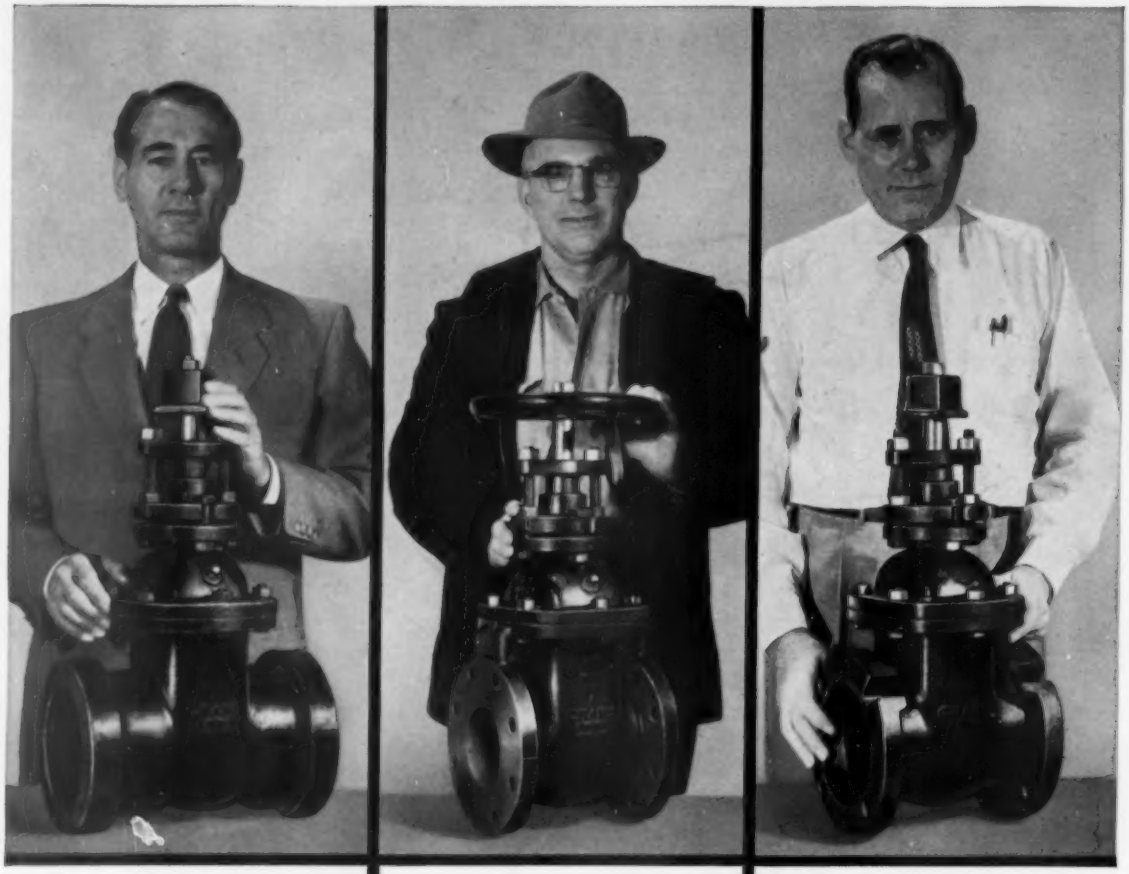
How will we live, eat, travel in the future? Even scientists must include some guesswork in their predictions of the marvelous things to come. But one thing seems certain—water and gas will still be carried by the dependable, long-lasting cast iron pipe laid today. Here's proof! More than sixty American cities are still being served by cast iron water and gas mains over a century old. And today's modernized U. S. Pipe...centrifugally cast, quality controlled . . . is even stronger, tougher, and more durable.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.



"We use CRANE A.W.W.A. *hub end* valves in our lines."

"We need CRANE A.W.W.A. *flanged end* valves."

"We like CRANE A.W.W.A. *mechanical joint end* valves."

New CRANE A.W.W.A. Valves Available with the 3 Preferred End Connections

Whichever of the 3 is best for you—hub, flanged, or mechanical joint end connection—you can have added years of dependable, trouble-free service with new Crane A.W.W.A. valves. They're made with all 3 of these popular ends.

These new gate valves feature free-to-rotate discs that prevent concentrated wear on seating surfaces . . . simplified wedging action that assures positive seating . . . disc flange guides that hold the disc assembly in close alignment for maximum operating efficiency and minimum wear . . . and strict compliance with *all* A.W.W.A standards for gate valves for ordinary water works service.

Specifications Supplied on Request

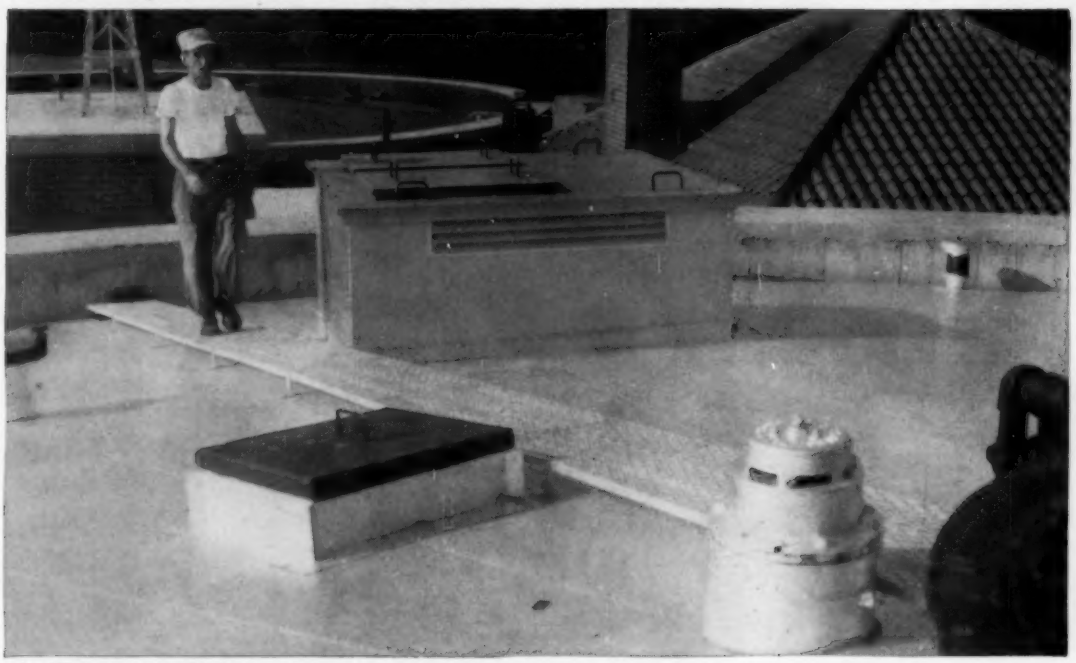
New Crane A.W.W.A. valves come in all sizes from 2 to 12 in. Circular AD-2108 will give you complete technical data and help in your selection. Get a copy from your local Crane Representative, or write to address below. No obligation.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

PFT Floating Cover with aluminum roofing on 65′ digester.



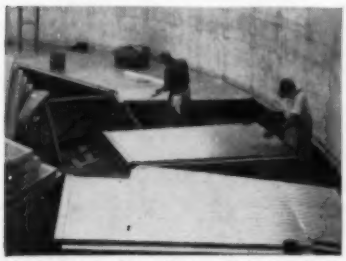
At Champaign-Urbana, Illinois . . .

A sewage plant invests in long-range economy

PFT metal roofing on new Floating Cover provides longer life, better insulation

With future economies in mind, the Champaign-Urbana Sanitary District specified a *PFT Floating Cover* with *metal-clad roofing* for their new 65′ diameter digester.

The metal roofing provides four distinct advantages over conventional wood types: (1) longer life—equal to the life of the Floating Cover, (2) more efficient insulation, (3) fewer maintenance problems, (4) easier assembly and installation.



Shown at actual installations, PFT metal sections are easily unpacked and assembled. Cardboard boxes in foreground contain panels as they are shipped.

Section of roofing showing (1) aluminum top sheet, (2) inch-thick fiber-glass insulation, (3) aluminum reinforcing channel, (4) corrugated supporting ribs.

PFT metal roofing consists of prefabricated sections with embossed aluminum top sheets, each piece marked for easy assembly at the plant site. The sections are designed for close fitting in the field with a 3″ lap of top metal covering at all joints (see illustration). Cutout sections are provided to fit around sampling walls, hatch framing, manholes, etc.

With fiber-glass insulation, PFT metal roofing resists heat loss and keeps digester heating costs at a minimum.

Ventilators are provided for the space between ceiling plate and roof deck. Also included is a 19″ wide walkway of galvanized steel, deformed for sure footing.

The PFT Floating Cover at Champaign-Urbana includes a complete *Pearth Gas Recirculation System*—an economical process that controls the formation of scum, making more effective use of the entire digestion tank capacity.

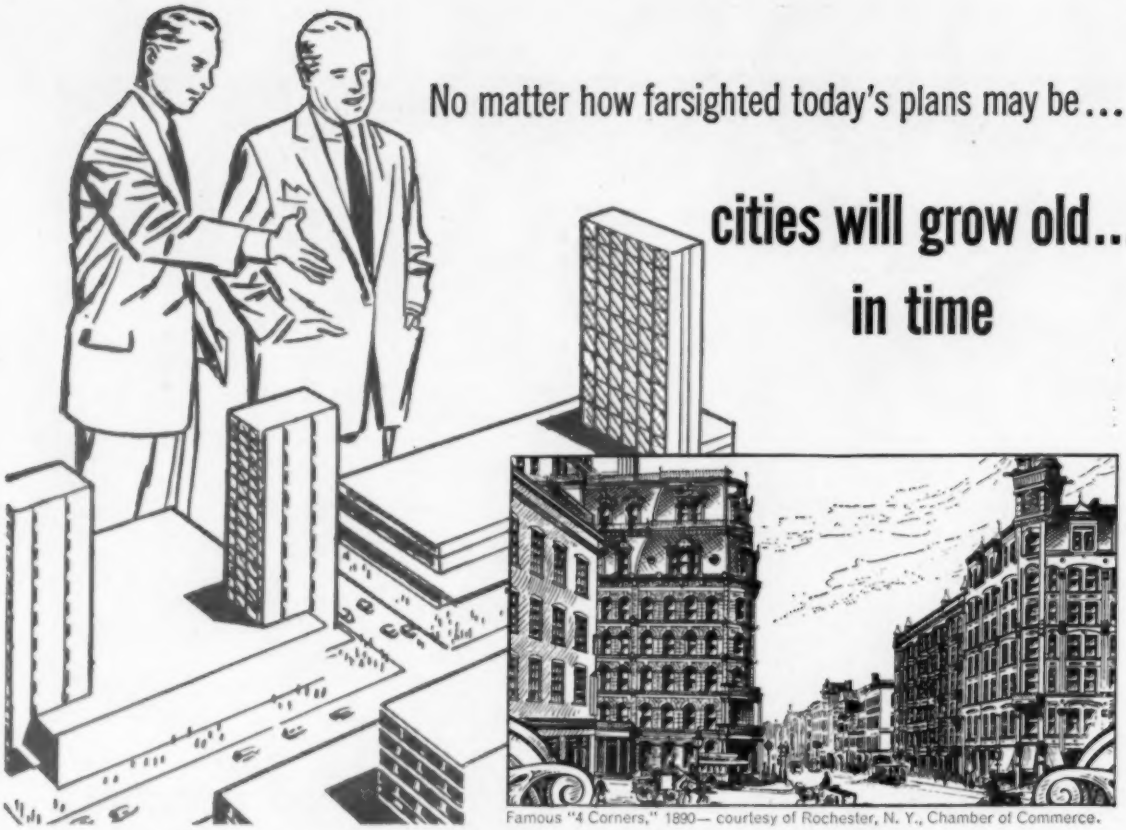
Design of plant by / *Wilson & Anderson, Consulting Engineers Champaign, Illinois*

waste treatment equipment
exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER



No matter how farsighted today's plans may be...

cities will grow old... in time

Famous "4 Corners," 1890— courtesy of Rochester, N. Y., Chamber of Commerce.

Your best insurance against obsolescence of your water system... specify EDDY Valves and Hydrants *throughout*

No matter how far into the future your city planning is projected, Eddy's record testifies that Eddy Valves and Hydrants are your best long term investment. Eddy Valve Company's more than 100 years of dependable operation means that, today, you can get replacement parts for any Eddy Valve or Hydrant ever installed. And our ability to continue to do so is your assurance against future obsolescence of your valves and hydrants.

EDDY Bronze-Mounted HYDRANTS open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below hydrant valve means that there is no water loss due to a bent stem.

EDDY Bronze-Mounted GATE VALVES offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, tell why progressive water works men have relied on Eddy for generations.

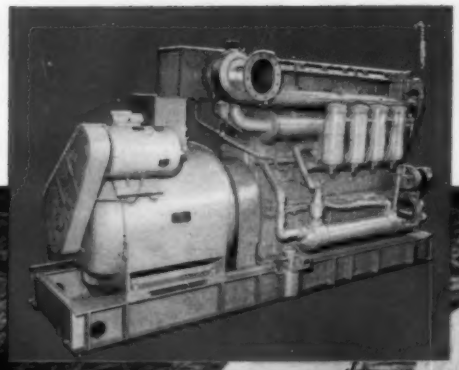
Eddy Hydrants and Valves are available with hub, flange or mechanical joint connections to fit any existing or planned installation.

Send today for full data on the complete line of Eddy Valves and Hydrants. No obligation.

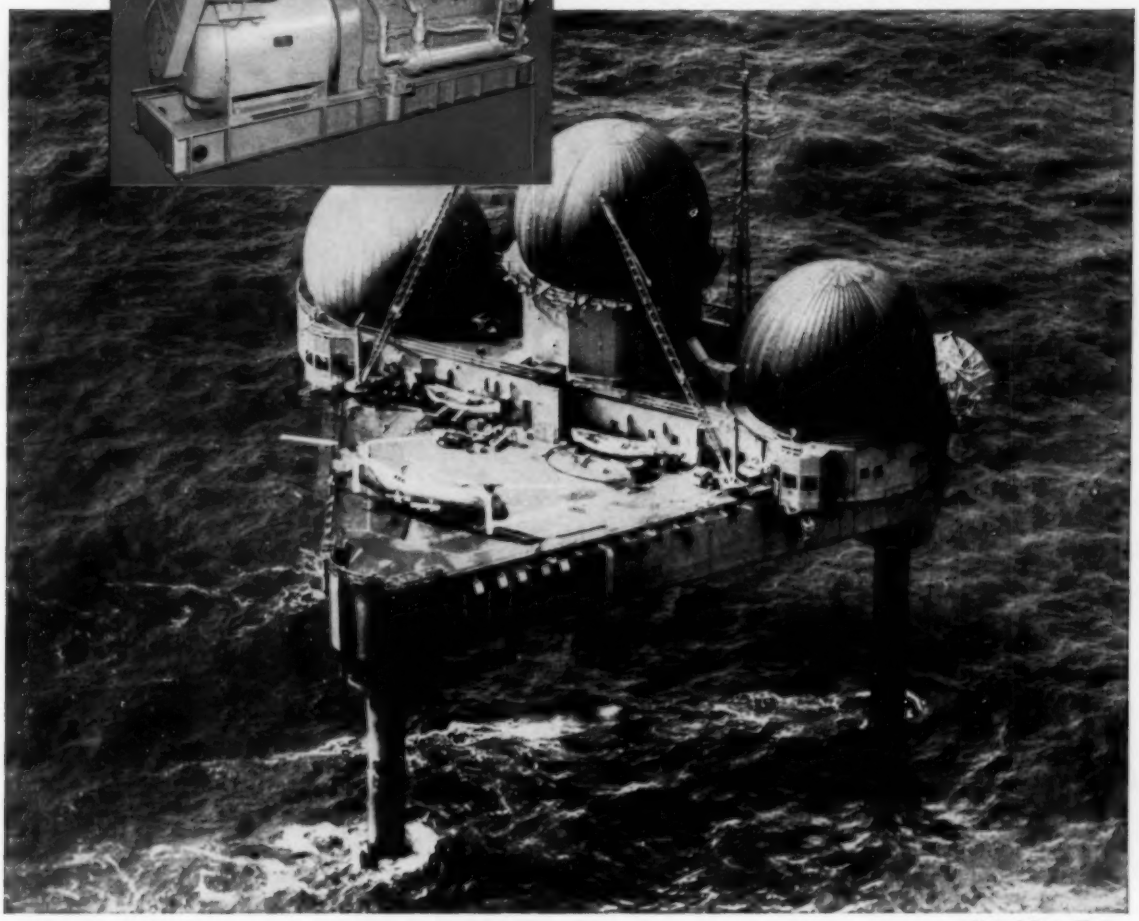
EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK



Powered by White's Superior Diesels...



United Press Photo

TEXAS TOWERS' WARNING WILL ALERT OUR NATION

This U. S. Air Force early warning radar station off the coast of Cape Cod is called the Texas Tower. Aboard the Tower, radar eyes search the skies. In the event of approaching enemy bombers, a push of one red button will warn our coastal areas and start our air defense into action!

Two more Towers are now being built for the U. S. Air Force by the U. S. Navy, to be a vital part of our nation's far-reaching radar air defense system. They require high-quality, heavy-duty equipment giving dependable performance with minimum maintenance over long periods of continuous service. White's Superior Diesel engines meet these requirements . . . they have been selected to generate the power for the vital radar operations, and also for the radio, communication, heating, lighting and ventilating equipment aboard the additional Towers.

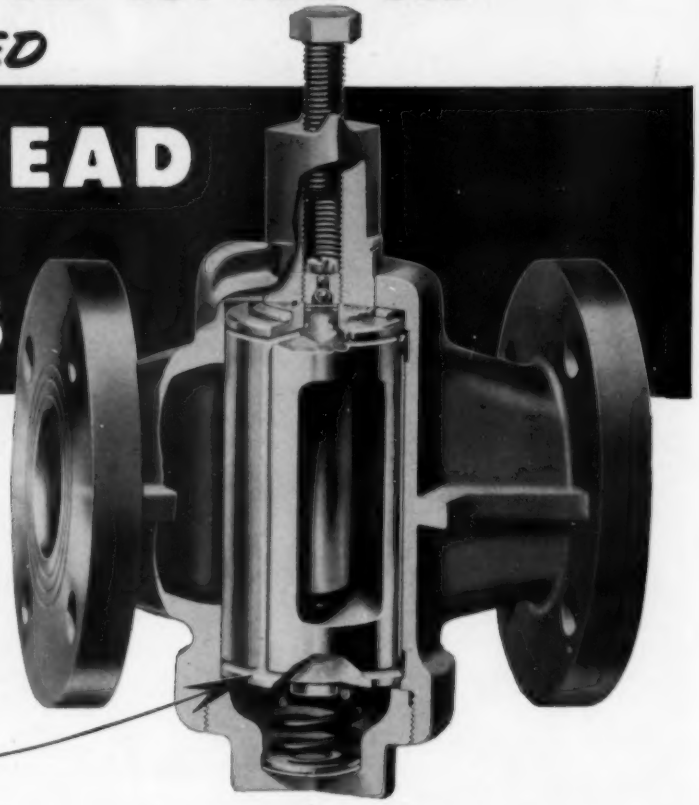
If you require rugged, heavy-duty, high-quality Diesel engines for the most dependable and economical operation, choose White's Superior Diesels. There's a size and type for virtually every requirement from 215 to 2150 horsepower, or 150 to 1500 KW. Get complete information now.

Superior ENGINES · ATLAS Imperial DIESEL ENGINES · White DIESEL

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY *Plant and General Offices: Springfield, Ohio*

No. 5* of 12 REASONS WHY
YOU SHOULD BUY AND USE
LOW-PRICED
HOMESTEAD
Lubricated
PLUG VALVES



*SELF-FREEING PLUG PREVENTS STICKING

Homestead's exclusive completely controlled lubricant system positively prevents sticking by its instant, piston-like movement of the plug downward at the start of each lubrication. Spring and line pressure return it to stem-sealed position.

This is only **one reason why you should buy and use low-priced** HOMESTEAD LUBRICATED PLUG VALVES.

HERE ARE ALL TWELVE

1. Extra long valve life assured by very close tolerance between sealing surfaces.
2. Straight line fluid flow—streamlined ports—minimum resistance to flow—minimum pressure drop.
3. Triple head seal—two lubricant rings and reinforced Teflon stem seal prevent leakage.
4. Easy turning—plug floated on Teflon washer and reinforced Teflon ring.
5. Self-freeing plug prevents sticking.
6. Full-threaded screw prevents dirt being forced into lubricant system.
7. Quarter-turn fully opens or closes.
8. Reinforced Teflon stem seal—no cold flow—continuous, positive seal.
9. Seating surfaces protected in both open and closed positions.
10. High pressure lubricant system provides full lubricant seal around ports.
11. Leak-proof double ball and lubricant sealed check valve. No springs. No maintenance.
12. Two lubricants handle most services.

FOR CATALOG AND COMPLETE DETAILS MAIL COUPON TODAY

HOMESTEAD
VALVE MANUFACTURING COMPANY
"Serving Since 1892"

P. O. Box 42 **Coraopolis, Pa.**

Without obligation, send Reference Book 39—Section 5 on HOMESTEAD LUBRICATED PLUG VALVES.

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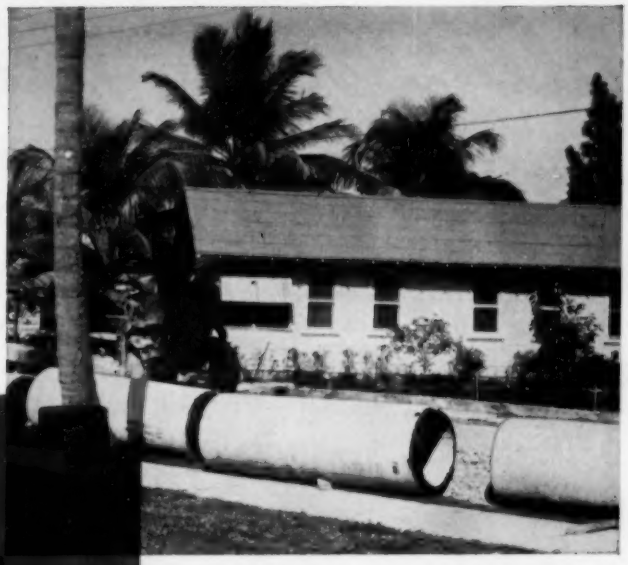
COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Look for TYLOX Rubber PIPE COUPLINGS



Where infiltration problems are "tough!"

In Miami*

ENGINEERS AND CITY OFFICIALS DEFEAT FLORIDA'S SUBAQUEOUS SOILS WITH TYLOX JOINTS TO KEEP "OUTSIDE WATER OUT" OF NEW CITY SEWERS

Miami's choice of TYLOX Rubber Joints for new sewerage lines not only solved infiltration problems presented by high water tables, but sped completion of the project, kept construction costs down and assured long-lasting *leakproof* lines. Here's how . . .

MORE PIPE DOWN PER DAY, with *fast-working* TYLOX to offset slow working conditions. TYLOX Joints are safely made in wet trenches, and backfilling can follow *immediately*.

NO JOINT FAILURES — Rubber TYLOX seals under *compression* . . . angularities in the line — or stresses from shifting soils or surface loads — are compensated by the natural resilience of the rubber.

NO CORROSION — Made of specially compounded rubber, TYLOX Joints are immune to sewerage and industrial waste acids and alkalies. *TYLOX outlasts the pipe itself.*

Write for complete details and more case histories on TYLOX, the *one* pipe joint that meets requirements of engineers, sanitary officials and construction men alike. Read the *facts* for yourself, and specify TYLOX to prevent infiltration, speed construction and lower cost on *your* next concrete or vitrified clay pipe project.

* **PROJECT:** *City of Miami — Sewerage Expansion*

PIPE: *Reinforced Concrete — Manufactured by United States Concrete Pipe Co., Cleveland, O.*

ENGINEERS: *For the City of Miami:*
Arthur E. Darlow, Director of Engineers
W. T. Eefting, Project Engineer, Design & Specifications
Robert Banning, Chief Construction Engineer
W. B. Lewis, Engineer of Designs

HAMILTON KENT MANUFACTURING COMPANY
Kent, Ohio
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"THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH RUBBER JOINTS"

Is *Water shortage* endangering the future of your community?

Badger Water Meters conserve present supplies by giving an exact accounting of usage and waste

Caught in a two-way squeeze between fast-growing population and booming industry, many communities suddenly find themselves with outmoded water facilities. The time to act is NOW if declining water supplies threaten the future of your community. Metering *all* water is the first logical step toward conserving present supplies . . . recording *where* and *how much* is used. Fair rates for all help keep water departments *self-supporting*. Safeguard tomorrow's water needs TODAY.

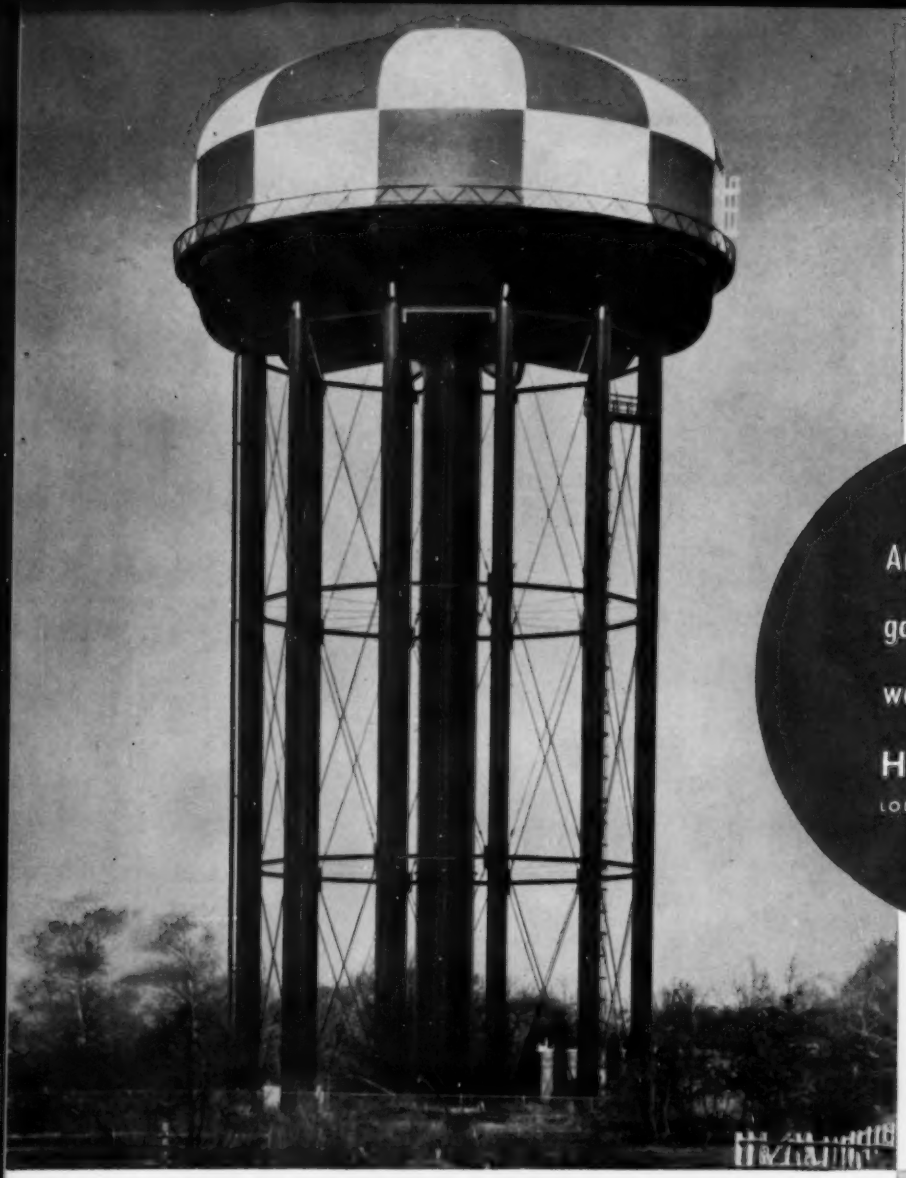
• For complete information on how metering can insure the future of your community, contact your Badger Meter salesman or write us direct:

Badger Water Meters

Water is Vital

Badger Meters have conserved it for 50 years

BADGER METER MFG. CO., MILWAUKEE 45, WISCONSIN



Another 1,500,000 gallons of "certain-sure" water service for **HEMPSTEAD** LONG ISLAND, N. Y.

1951

Elevated Steel Tanks by

PITTSBURGH-DES MOINES

Latest of the many PDM Elevated Steel Tanks towering over Long Island's level terrain is this 1,500,000-gallon Radial Cone installation for Hempstead. 88 ft in diameter, the tank has a headrange of 35 ft and is on a tower 135 ft to bottom of capacity. Shown at right is an earlier million-gallon PDM tank of the same design, built for Hempstead in 1951.

● Write for our new Modern Water Storage Catalog.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN

Sales Offices at:

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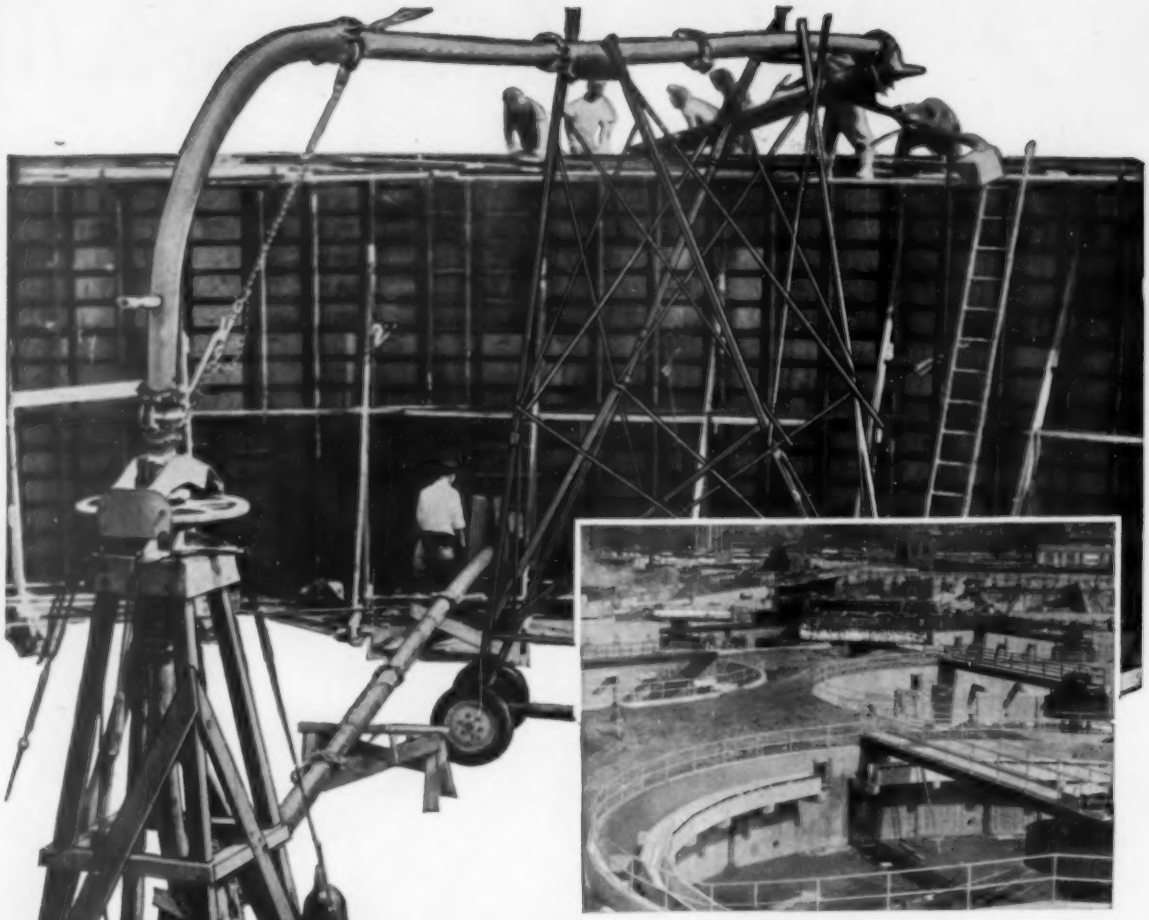
SANTA CLARA, CAL.....649 Alviso Road

PDM
ELEVATED STEEL TANKS



Unique method of placing concrete saves time and money at Grand Rapids sewage plant

Using a special swivel pump rig to place concrete in six 100-ft. diameter settling tanks at the Grand Rapids, Mich. sewage treatment plant saved considerable time, labor and money.

As the photo shows, concrete was pumped through a rotating conduit and deposited continuously in the forms. Each tank required 180 cu. yd. of concrete and was completed in a seven-hour day by a seven-man crew.

This demonstrates concrete's adaptability to the special conditions of any job. Placed by this or another method, concrete is the ideal material for sewage treatment plants and facilities.

Concrete is moderate in first cost. It requires little or no maintenance. It has extremely long life. The result is ***low-annual-cost*** service.

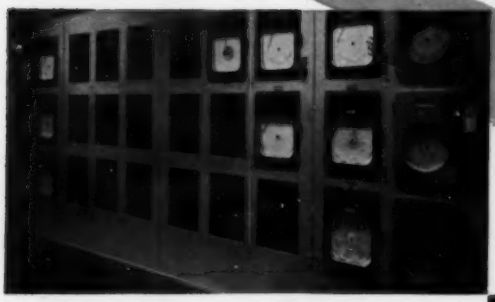
For more information on concrete construction for sewage treatment plants write for a free illustrated booklet, "*Sewage Treatment Works.*" Distribution limited to the U. S. and Canada.

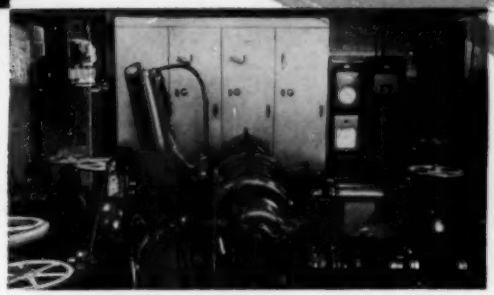
PORTLAND CEMENT ASSOCIATION Dept. 8-29, 33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

to SEE and DO...

over the miles





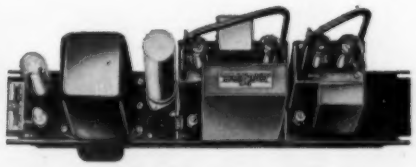
DO IT THE PRACTICAL WAY

with HAMMARLUND

Centralized Operations Control

You can control hard-to-reach points in your water system from a central location with dependable Hammarlund Centralized Operations Control equipment. COC units act as the link between various substations and main office, utilizing a standard telephone pair to convey telemetering information or to carry control and supervisory indication signals. Pumps, motorized valves, or any other mechanized equipment can be directly or proportionally controlled, and flow, level, and pressure readings can be telemetered—simultaneously! With Hammarlund COC equipment installed in your present system, you can greatly increase your services without increasing your costs by utilizing in most instances, your **present** equipment and personnel. COC is extremely economical. In most installations it has paid for itself in less than two years. For complete details, write for Bulletin WSW-856.

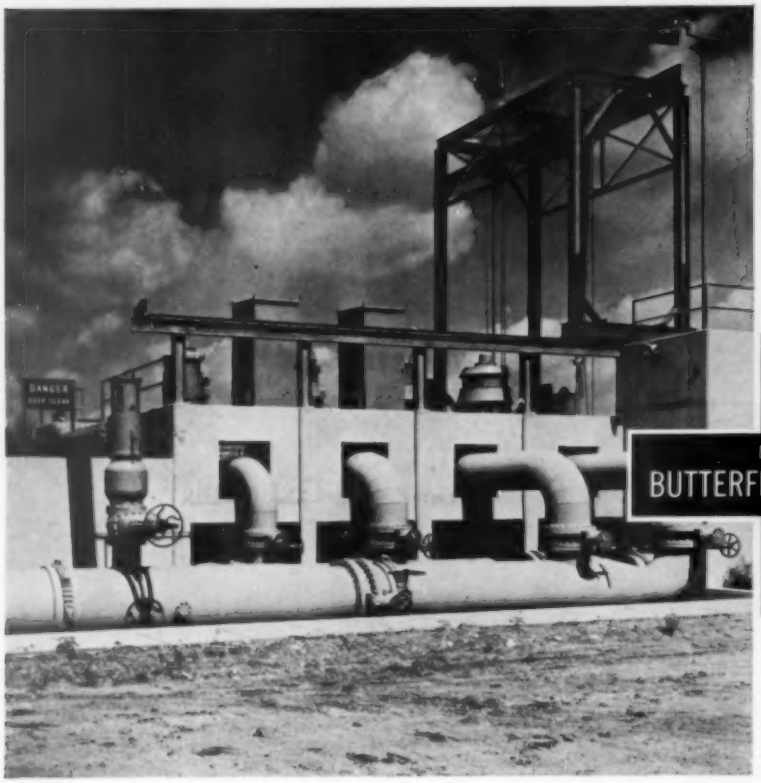
COC equipment is made up of Dual Signalling Units, Single and Dual Transmitter Units, and Single and Dual Receiver Units mounted on standard 19" panels. With this design, additional functions can be achieved with Hammarlund's add-a-panel packaging — without re-engineering the existing control system.



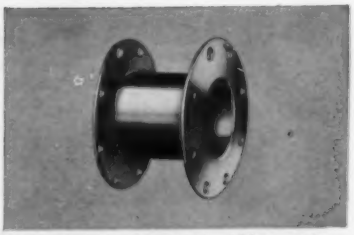
Established 1910

HAMMARLUND
MANUFACTURING COMPANY, INC., 460 West 34th Street, New York 1, N. Y.
INTERNATIONAL DIVISION: 13 East 40th Street, New York 16, N. Y.

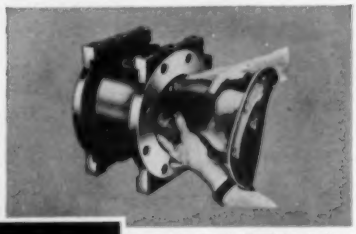
Use of compact R-S Rubber-Seated Butterfly Valves in this common header permitted close coupling of all pipe, resulted in a substantial saving.



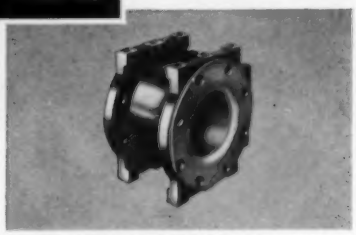
R-S
BUTTERFLY VALVES



Renewable & replaceable rubber seat . . .



. . . Is installed in valve body . . .



. . . And positions with flanges fitting body flange holes . . .

FOR DROP-TIGHT SHUT-OFF AND ABRASION RESISTANCE

R-S Rubber-Seated Butterfly Valves give 100% effective shut-off with 125-pound pressure drop. Wedge-type action of the vane against the tough flexible rubber seat gives positive closure even around the shaft bosses. The special compositon of rubber and other materials gives long life and resistance to wear caused by the flow of materials.

Use of R-S Butterfly Valves in place of conventional gate valves will give a far more compact piping layout. This can mean substantial savings in the initial building cost. To get full information on the complete line of Butterfly Valves, Ball Valves, and Rotovalves, see our local representative or write S. Morgan Smith Co., York, Pa.

SMS

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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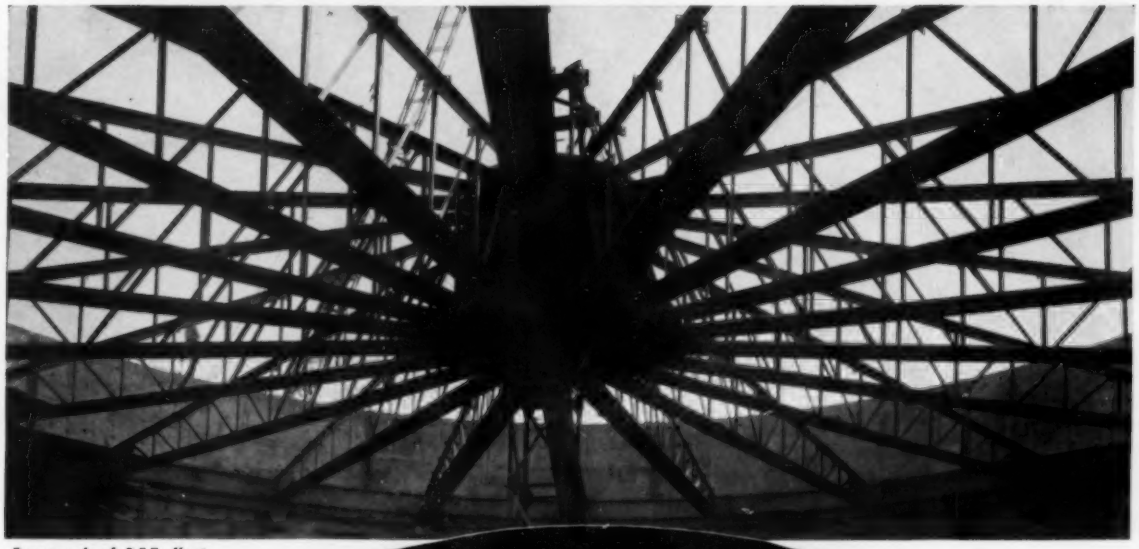
FREE-DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

FRAMEWORK of Economy



Framework of P.F.T. floating cover being built for a sewage digestion tank.

Five sewage digestion tanks with steel floating covers and a 50,000-gal. Horton Watersphere® at the Sacramento Sewage Disposal Plant.

for Sacramento Sewage Disposal Plant

This intricate framework was built for one of the five P.F.T. steel floating covers installed on the 100-ft. diam. digestion tanks at the City of Sacramento's sewage disposal plant by the Chicago Bridge & Iron Company. The floating covers aid the economical production and recovery of sludge gas which in turn, is used to heat sludge and for heating buildings. This is but one example of CB&I's ability to build welded steel plate structures for economy and utility. Write our nearest office for further information on tanks and steel plate work.

CB&I

Chicago Bridge & Iron Company

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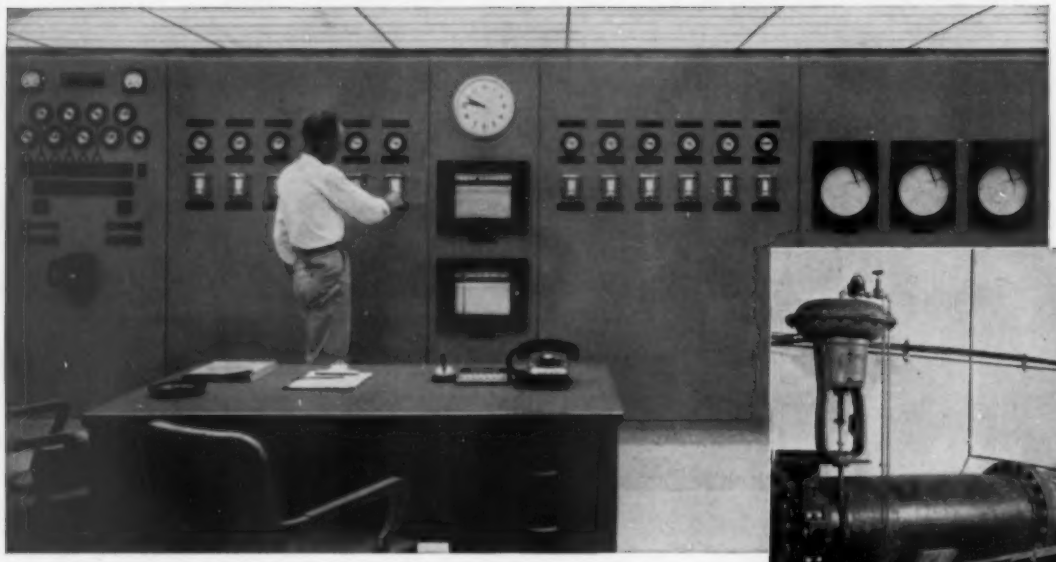
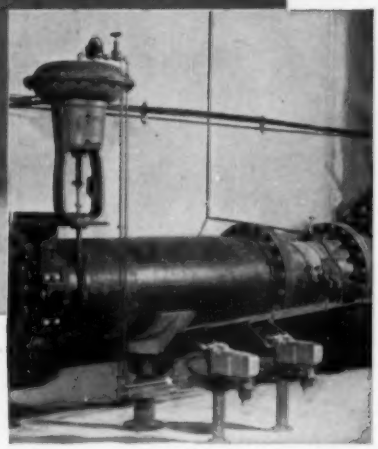
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY *and* GREENVILLE, PA.



***Filter house control panel** puts complete control of this 48-mgd plant in the hands of one man. The plant was designed by Reagan and McCaughan, Consulting Engineers, Corpus Christi.*



***In the pipe gallery,** these Honeywell Mercuryless **Differential Converter** pneumatic transmitters measure loss of head and filter effluent flow. Remotely set Honeywell diaphragm actuators position butterfly valves to hold desired filtering rate.*

One man controls 48-mgd through 12 filters at new Corpus Christi plant

. . . using Honeywell *Filtermatic** System

CENTRALIZED instrumentation, incorporating a Honeywell *Filtermatic* control system, increases efficiency and cuts supervisory work load at the new O. N. Stevens Water Filtration Plant at Corpus Christi, Texas. At his instrument panel, a single operator can see everything he needs to know about the functioning of 12 filters that treat 48 million gallons of water daily. All filtering controls are right at his finger tips. During backwashing, valves are positioned and flow rates adjusted from individual filter consoles. There's never any need to go down to pipe galleries to operate this plant.

Tel-O-Set miniature indicators which show rate of flow through each filter, permit individual adjustments of filtering rate set points, and provide continuous indication of filtering rate and desired filtering rate. In addition, a 12-point *ElectroniK* instrument records all these flow values on a single wide chart. Loss of head for each filter, indicated by individual dial gages, is recorded by another 12-point *ElectroniK* instrument. There are also recorders for clearwell level, wash water tank level, plant effluent main pressure, plant effluent flow, and wash water flow.

Honeywell service on this installation covered not only application engineering of the control system, but also complete fabrication, piping and wiring of panels in Honeywell's Houston service shop. This complete service lowers construction and installation costs, and assures adherence to construction and startup schedules.

A Honeywell field engineer will be glad to talk over your filter plant control, with you and your consulting engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Phila. 44, Pa.—in Canada, Toronto 17, Ontario.

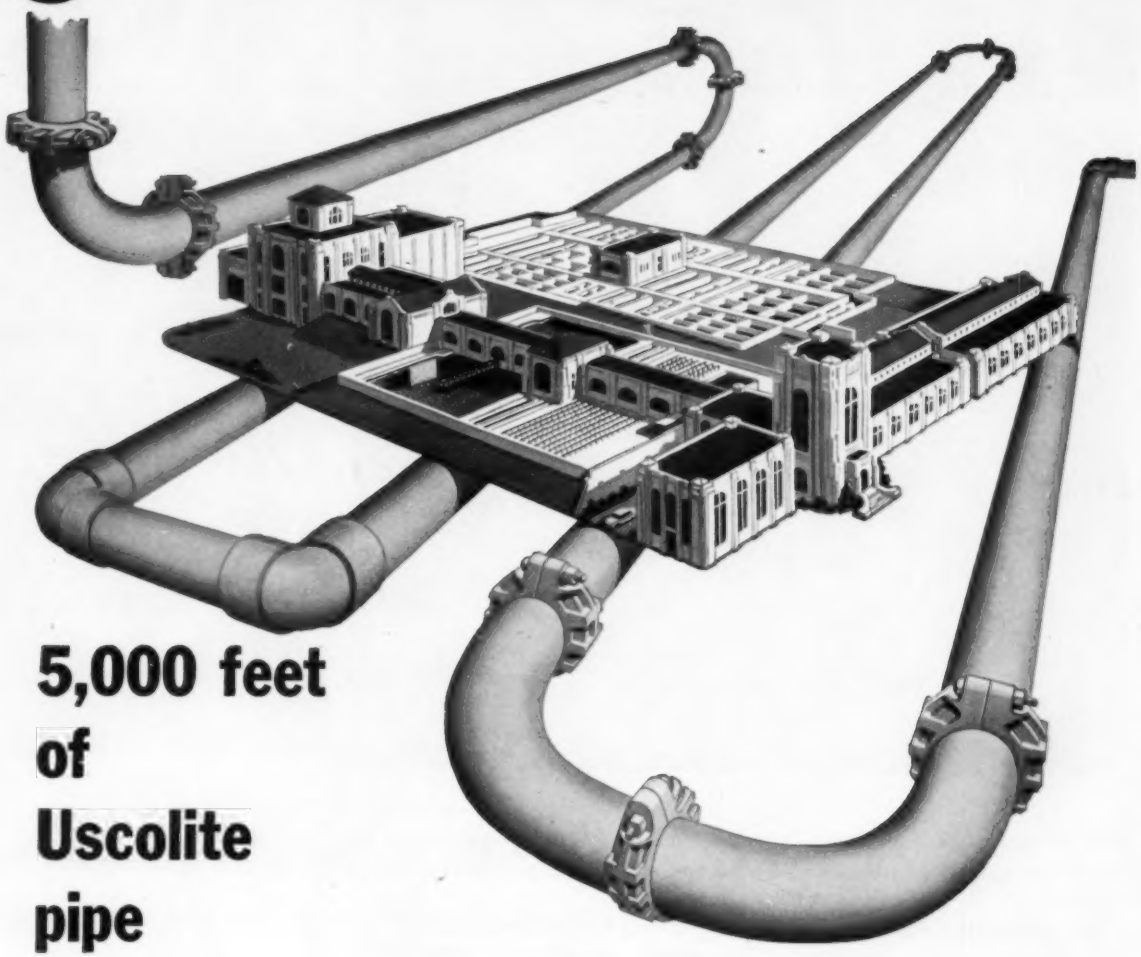
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

*Trademark of Minneapolis-Honeywell Regulator Co

USCOLITE PIPE



5,000 feet of Uscolite pipe

in the chlorination lines of Fort Wayne's new water-filtration plant

One of the most modern installations of its kind in the world is the new water-filtration plant of the Fort Wayne City Utilities. As part of its modernization program, it required an extensive system of new chlorine solution lines—lines that would be corrosion resistant and absolutely non-contaminating. So they chose Uscolite® plastic pipe—5,000 feet of it. It is used to carry chlorine solution and a phosphate solution.

Uscolite piping is resistant to acids, salts, alkalies and gases—both inside and out. It is non-toxic, imparts no odors and gives unimpeded flow at all times. Despite its great impact strength, it is amazingly light in weight. It is easy to cut and thread with standard equipment.

The complete Uscolite line—it includes elbows, tees, flanges, couplings, reducing bushings, caps, valves—is obtainable at any of our 28 District Sales Offices, each staffed with factory-trained engineers, or at selected "U. S." distributors. Or write us at Rockefeller Center, New York 20, New York.

National Sanitation Foundation seal of approval awarded to Uscolite Pipe.

Mechanical Goods Division

United States Rubber

THIS OPEN DOOR GUARDS YOUR MOST VITAL SERVICE

Water is your community's life blood. Water meters are universally accepted as the fairest way to charge for water . . . and the only way to keep people from wasting water.

But water meters, being fine instruments, naturally lose accuracy after years of wear. They start to give away revenue. They permit leaks and carelessness to creep back, and pumping costs go up. Eventually the water system cannot cope with the growing demand.

Worse yet, lack of proper income makes people hesitant to act, and water shortages may soon become critical.

How guard against this? Pick meters that stay accurate longer. Set up a good testing and repair program.

Walk into your meter repair shop. Talk to the men whose efforts guard your water supply. Ask them which meter gives highest sustained revenue . . . with lowest repair and depreciation costs. We sincerely believe the answer will be "Trident."

376

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WATER & SEWAGE WORKS

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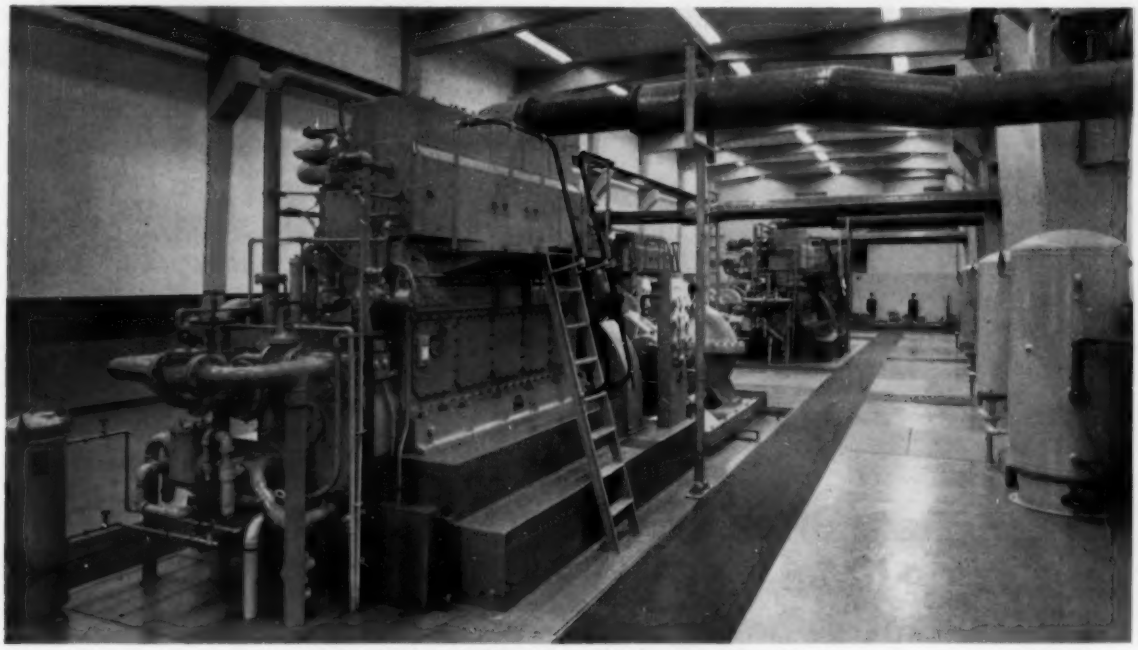


TWO of the four high pressure Diesel powered pump units.

Miami's Newest Water Plant . . Part 2*

Diesel Powered Pumping Station a Feature

Also diesel powered wells assure water supply during and after hurricanes

DIESEL ENGINES enable Miami's Alexander Orr Treatment Plant to maintain full scale operation during periods of outside electrical power interruption. The 40 mgd softening plant which was described as Part I of this article, published in the March 1956 issue of *Water & Sewage Works,* has a reserve well field capable of meeting the design rate of the plant. This standby field consists of seven wells, all with diesel-powered pumps, is separate from the normally operated permanent well field with its electrically operated units. Diesels at the plant drive all four high pressure pumps, and a generator capable of supplying *all* electric power needs of the treatment plant and pumping stations.

South Florida's hurricane season extends from June through November. Diesel engines at the Orr Plant reinforce other emergency pumping facilities in the Miami system in case of electrical power outage caused by hurriance force winds or other adverse conditions.

Reserve Wells

The reserve wells are located adjacent to the plant site and discharge into the pipeline coming from the permanent well field. They were designed to be used in event of power failure at the permanent well field located four miles from the plant, or in event of

* Part I of this article was published in the March 1956 issue of *W.&S.W.*

by D. B. PRESTON and R. J. BREHM

Mr. Preston is Sanitary Engineer of the Department of Water and Sewers, Miami, Florida.

Mr. Brehm is Superintendent of Miami's new Alexander Orr Jr. Water Treatment Plant and Pumping Station.

TWO of the seven stand-by well houses.

trouble with the pipeline from the permanent well field. In addition to the above purposes, they have been used in conjunction with the permanent well field to reduce on-peak power demands, thus effecting a reduction in rate paid for electric power. They have been used in some instances when peak water demands have exceeded the 46 mgd capacity of the permanent well field. It is not proposed to use these wells extensively since their location is less favorable than the permanent well field from the standpoint of salt water encroachment from the bay.

There are seven reserve wells with equipment housed in reinforced concrete and concrete block structures, as here pictured. The 6 mgd, Byron-Jackson, vertical turbine well pumps are driven by General Motors 6-71, two cycle diesel engines through right angle gear drives, as also pictured. Two diesel engines are provided in four of the well houses. Only one engine is needed to deliver water at low pressure to the treatment plant; however, two engines coupled with V-belts were used prior to treatment plant construction to pump chlorinated well water directly into the distribution system.

High Pressure Pumping

The Orr Plant is located adjacent to a residential area and the assurance of noise-free and smoke-free operation was paramount in the design of the high pressure pumping room. The pumping structure consists of reinforced concrete frames supporting a reinforced concrete roof and a 5-ton traveling crane system. There is a double east wall. The outer wall is constructed with screened and louvered openings below roof height and the inner or curtain wall terminates six feet above floor level with a screened opening, thus forming an inlet air duct. Located near roof height on the west wall are nine 25,000 cfm exhaust fans. (These fans are visible in the cover picture on this issue.—Ed.) Walls are sound proofed with acoustical tile and there is an acoustical tile suspended ceiling. Other wall surfaces and framing are covered with flintkote and plaster. All lighting is artificial with the exception of that afforded by glass block panels below the ventilating fan level along the west wall. Engine exhausts are equipped with Maxim silencers installed outside the building with exhaust gasses vented some 30 feet above ground. There has been no smoke, odor or noise nuisance during the two years of operation of this station.

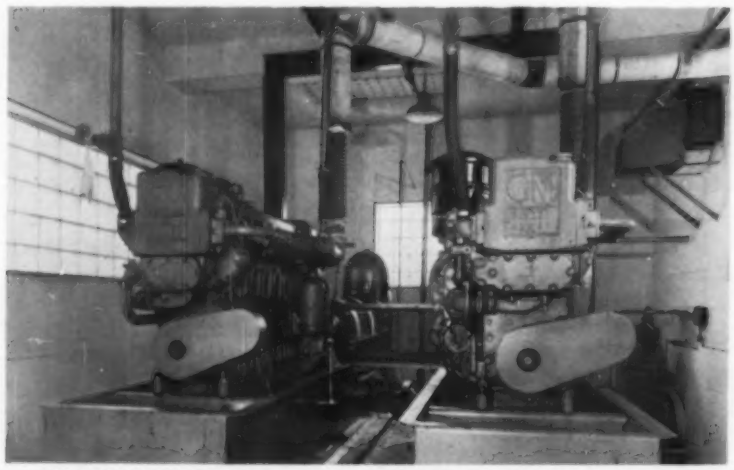
Engines and Pumps

There are four high pressure Worthington centrifugal pumps, each rated at 15.5 mgd at 225 feet total head at 880 rpm. These are driven by 825 hp, 4 cycle, five cylinder, supercharged, Worthington diesel engines. The engine speed range of 405 to 450 rpm permits a flexible range of pump operation. A speed increaser gear with a 1.958 to 1 ratio is provided between each engine and pump. One of the diesels drives a 724 kva, 2400 volt, 3 phase, 60 cycle generator. The generator can supply all plant electrical power needs. An air clutch is provided between the generator and pump, and it has been the practice to operate the generator and pump simultaneously within the load capacity of the engine. The bottom suction, centrifugal pumps have 30 inch diameter, suction pipe lines which are located in chases. The suction lines are equipped with Pratt, rubber seat, butterfly valves. S. Morgan Smith, 16 inch, solenoid control, hydraulically operated cone valves are provided on each pump discharge. The solenoids are energized by 12 volt, d.c. generators driven by the diesel engines. The solenoids are de-energized at reduced engine speeds.

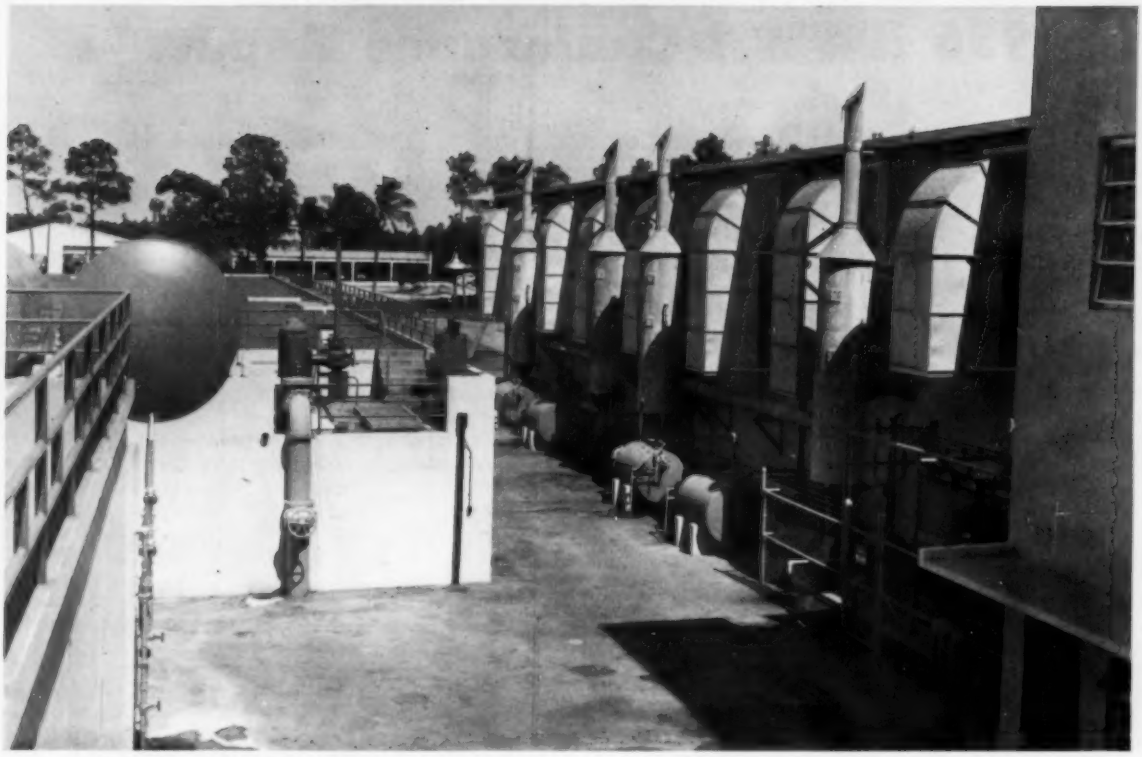
No. 2 diesel fuel is delivered to the plant by tank truck and is transferred to a 60,000 gallon welded steel storage tank constructed above ground. The fuel is pumped through filters to 550 gallon horizontal steel day tanks located at the rear of the station—see photo. Individual lube oil and jacket water heat exchangers are also located outside the station.

Station Operation and Maintenance

The diesel pump room is operated by one man on each eight hour shift.



TWIN DIESELS in well houses drive Byron-Jackson vertical turbine pumps.



PUMPING STATION from rear shows exhaust for air ducts, Maxim silencers, day fuel oil tanks.
On left are sodium silicate storage tanks and wash water pump.

No. 2 diesel fuel with a B.T.U. value of 19,350 per pound is used, with fuel consumption averaging 45 gallons per million gallons pumped at a total head of about 170 feet. Engine lube oil is checked weekly for dilution, soluble pentane and organic acids. When necessary, lube oil is purified by heating to 425° F under vacuum and filtering through cellulose. Lube oil makeup amounts to about 0.2 gallons per million gallons of water pumped.

Two full-time diesel mechanics are carried on the payroll for diesel maintenance. The routine and special maintenance time on the high pressure pumping station equipment has averaged 150 hours per month during the past year. Maintenance materials expenses have averaged $60.00 per month during the same period. The total operating time as of May, 1956, averaged 5700 hours per engine. The first complete overhaul inspections are scheduled for 10,000 hours.

Steps are already underway to expand the pump room by the addition of a fifth unit. The 25 mgd pump will be powered by a 1375 hp diesel engine.

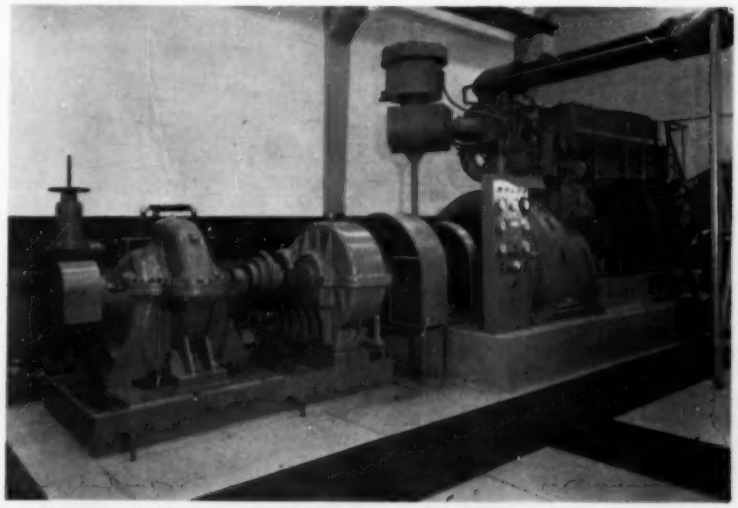
Summary

Diesel engines permit the Orr Plant to maintain full operation during periods of electrical power interruption. There is a diesel powered well field rated at plant design capacity in addition to diesel powered high pressure pumps and a diesel driven generator.

Four reserve well stations were constructed in 1949 and three stations were constructed in 1952. The cost of these stations was $256,480.

The cost of the high pressure, all Diesel powered pumping station was $550,000.

The management of Miami's water facilities is under C. F. Wertz, Director of the Department of Water & Sewers.



DIESEL with generator produces all electric power plant requires while pumping at the same time.

1956 AWWA Conference Report—1

Water Works Administration and Practice Committee Sessions
Management and Resources Divisions

IN THE PREVIOUS issue, *Water & Sewage Works* carried a complete report on the general features and the business and entertainment actvities of the Diamond Jubilee Meeting of AWWA held in St. Louis, Mo., May 6-10. In this installment, we present reports on five of the technical sessions. The next installment will carry reports on the remaining technical sessions.

John H. Murdoch

M. B. Cunningham

R. J. Faust

Water Works Administration

Water Works Administration*

The annual open session of the Water Works Practice Committee was held on the first morning of the convention with AWWA President, F. C. Amsbary, Jr. as Chairman and W. R. LaDue as Co-Chairman. The session was devoted to task group reports.

California Commission Rules

"Rules and Regulations of the California Commission" were discussed by W. C. Welmon, Secy-Treas. Southern Calif. Water Co., Los Angeles. Particular mention was made of a tentative order by the Calif. Pub. Util. Comm. covering service rules and standards affecting new construction, to be promulgated by the Commission. It also establishes relations between the utilities and Commission rather than between the utilities and their customers.

The California Section, at the invitation of the Commission, appointed a 36-member committee to make a study of the proposed order and come up with its own set of rules for consideration by the Commission in substitution. This was carried out under three headings: (1) Rules & Regulations; (2) Meters & Metering; (3) Construction & Engineering Design. Representatives of the Committee and Commission have had several meetings together and a fine spirit of cooperation has developed between them. One result of these meetings has been a revelation that the Commission is not aware of operating problems, and that the Committee is not aware of regulatory problems.

The various points of difference between NARUC rules—the main source of material for the Commission order—and those proposed by the Committee were brought out. Among these were rules covering restoration of service after discontinuance; pressure at customer's inlet, dead-end flushing, inspection of customer service lines and plumbing, meter test flows, spacing of periodic meter tests, service extension rules, etc.

Mr. Welmon concluded that water utilities should cooperate with utility commissions because in that way they may obtain workable rules with which to live.

NARUC Regulations

John H. Murdock, Jr., Vice President and Counsel, Amer. Wat. Wks. Service Co., Philadelphia, Pa. gave a short explanation of the "NARUC RULES AND REGULATIONS." Most of the time of those bodies whose members compose this group is taken up with gas, telephone, and electric power company cases, these being, for the most part, privately owned companies coming under the jurisdiction of state regulatory bodies. Most water systems, being publicly owned, are not affected.

A.W.W.A. is interested in NARUC rules because it is afraid unwise regulations might be applied to publicly owned utilities. Mr. Murdoch urged cooperation with the California Section Committee on Rules and Regulations. He stated that NARUC physical standards are high and excellent, but so high it would bankrupt an old plant to conform to them throughout and in every instance, although a new plant might be able to meet them satisfactorily.

Rating Water Systems

Mr. Murdoch also described the work assigned to Task Group 2220.M —"RATING WATER SYSTEMS"—as the devising of a method to determine the relative efficiency of water systems, making it possible to improve water service through competition in efficiency.

With the work of this Group just beginning, regional sub-task groups are being set up to consider the subject under six headings: (1) Financing, Rate Structure and Metering; (2) General and Customer Accounting, Billing and Collecting and Recording of Data; (3) Managerial Responsibility and Authority, Personnel Training; (4) Source of Supply, Transmission and Provision of Pressure; (5) Purification and Treatment; (6) Distribution.

There can be no arbitrary fixing of standards without bringing in various affecting conditions. It will be the duty of the Task Group to give value to these and eliminate as much as possible all judgment factors in connection.

In explaining what is meant by efficiency in a water works system, Mr.

* Reported by H. Wilkens, Jr., Mgr., Texas Water Co., Houston, Tex.

Murdoch included efficiency in planning, loss and waste control, records, the economic use of available capital and resources coupled with accomplishment of services desired by the customer as reasonably as possible.

When finished, the rating system would be applied by local management or by an outside agency. AWWA could not or will not make the ratings; it will only make the rating system available.

Mobile Radio Use

M. B. Cunningham, Dir., Public Works, Oklahoma City, Okla. reported on the "SURVEY OF MOBILE RADIO USE."

The principal function of this committee during the past year has been to work with the F.C.C. A survey of the water works field found 429 water departments had licenses to operate radio facilities, with 427 new applications for licenses to be filed. The extent of use of common facilities with police, fire, and other departments was not determined, but is considerable. Of the 1262 cities with 10,000 population and over, a majority are using or plan to use mobile radio in their water departments.

Mr. Cunningham urged active participation by AWWA in the work of the National Committee for Utility Radio which, among other things, has recommended the use of radio for tone and code signal transmission for control purposes.

Water Works Safety

According to R. J. Faust, Exec. Asst. Secy., AWWA, the Water Works Safety Committee has made excellent progress and copies of its report are available for distribution. With 99.3 per cent of all water utilities classed as small businesses employing fewer than 100 men, and 93 per cent fewer than 10 men, most injuries occur in the smaller plants where it is most difficult to set up a planned safety program. Because of our poor safety record we are starting at the bottom and can only go up.

To make the best progress, there must be some incentive other than just improving the record, and an awards system for Sections was suggested even though this might not be the final answer. It was recommended that each Section form and actively support a Safety Committee; and that the AWWA Safety Manual should be placed in the hands of every foreman and, if feasible, every man in the plant and field.

Education

Mr. Faust also called attention to the report of the Committee on Education published in the AWWA Journal two years ago. At that time there were 30 in-service training courses held throughout the country, attended by some 2300 people.

The Committee will concern itself with furnishing six basic training course manuals: (1) Basic Water Works Operation; (2) Advanced Water Works Operation; (3) Ground Water Production and Treatment; (4) Surface Water Production and Treatment; (5) Distribution; (6) Management.

The problem of how to get all the manuals written is now being tackled. Because the Management Manual would be too much for one man to write, a committee of 15 or 20 will be selected to do the job. In connection, the Committee is also studying the level at which to aim the manuals, the college level being thought of as the most desirable at this time, it not being considered proper to talk down to anybody. The operator should study and look up to information rather than have it presented to him at his own level.

L. R. Howson

J. G. Carns

T. E. Larson

Water Works Practice

Water Works Practice

The Water Works Practice Committee also held an open session presided over by the chairman of the committee, Louis R. Howson, Chicago consulting engineer.

Meter Standards

A PROGRESS REPORT ON METER STANDARDS was presented by James G. Carns, Meter Engr., American Water Works Service Co., Philadelphia, Pa. Mr. Carns is chairman of Committee 8610-D-Meters. One phase of the committee's work has been completed, namely, Recommended Water Meter Test Specifications.

Until now there have been no nationally recognized water works testing specifications. The nearest approach was the accuracy requirements in various AWWA meter specifications but these specifications make no provisions for different rates of flow for testing, etc. As a result each utility had to develop its own testing procedure.

As a basis of the new standard, the committee reviewed all State Commission rules and made a survey of water meter testing practices in 300 different utilities. These studies confirmed the wide variation believed to exist in practice.

The committee set up three basic factors involved in testing water meters:

1. The number of different rates of flow over the operating range of a meter required to determine over-all meter efficiency.

2. The quantities of water necessary at the various test rates to provide reasonable determination of meter registration.

3. Accuracy limits which meters must meet on the different rates to be acceptable for use.

Three rates of flow are necessary for proper testing positive displacement and propeller type meters; these are maximum, intermediate and minimum. One or more additional test rates are necessary within the "change-over" range of flows of compound meters.

Maximum registration is usually obtained at about 10 per cent of maximum capacity and above this point the accuracy curve is fairly flat so that there is little difference in accuracy over a wide range of flows. Selection of the maximum rate at which meters are tested, therefore, is not of major importance; approximately ¼ of maximum rated capacity appears to be practical.

The intermediate rate should be at or near the high point of registration to insure against over-registration of the meter on any rate of flow and should therefore be at about 10 per cent of rated capacity. The minimum rate selected discloses operational ability and proficiency of meter re-

Positive Displacement Meters

Size	Maximum Rate: Rate in G.P.M.	Maximum Rate: Test Quantity Gals.	Maximum Rate: Test Quantity Ft.	Maximum Rate: *Accuracy Limits in %	Intermediate Rate: Rate in G.P.M.	Intermediate Rate: Test Quantity Gals.	Intermediate Rate: Test Quantity Ft.	Intermediate Rate: *Accuracy Limits in %	Minimum Rate: Rate in G.P.M	Minimum Rate: Test Quantity Gals.	Minimum Rate: Test Quantity Ft.	Minimum Rate: Accuracy Limits in % *New Meters	Minimum Rate: Accuracy Limits in % **Repaired Meters
5/8"	15	100	10	98.5-101.5	2	10	1	98.5-101.5	1/4	10	1	95-101.5	90-101.5
3/4"	25	100	10	98.5-101.5	3	10	1	98.5-101.5	1/2	10	1	95-101.5	90-101.5
1"	40	100	10	98.5-101.5	4	10	1	98.5-101.5	3/4	10	1	95-101.5	90-101.5
1-1/2"	80	1,000	100	98.5-101.5	8	100	10	98.5-101.5	1-1/2	100	10	95-101.5	90-101.5
2"	120	1,000	100	98.5-101.5	15	100	10	98.5-101.5	2	100	10	95-101.5	90-101.5
3"	250	1,000	100	98.5-101.5	20	100	10	98.5-101.5	4	100	10	95-101.5	90-101.5
4"	350	1,000	100	98.5-101.5	40	100	10	98.5-101.5	7	100	10	95-101.5	90-101.5
6"	700	1,000	100	98.5-101.5	60	100	10	98.5-101.5	12	100	10	95-101.5	90-101.5
Current Meters													
1-1/2"	80	1,000	100	97-103	15	100	10	97-103	7	100	10	95-103	90-103
2"	120	1,000	100	97-103	20	100	10	97-103	10	100	10	95-103	90-103
3"	250	1,000	100	97-103	30	100	10	97-103	15	100	10	95-103	90-103
4"	400	10,000	1,000	97-103	50	1,000	100	97-103	20	1,000	100	95-103	90-103
6"	1,000	10,000	1,000	97-103	100	1,000	100	97-103	30	1,000	100	95-103	90-103
8"	1,600	10,000	1,000	97-103	200	10,000	1,000	97-103	50	1,000	100	95-103	90-103
10"	2,500	10,000	1,000	97-103	300	10,000	1,000	97-103	75	1,000	100	95-103	90-103
12"	4,000	10,000	1,000	97-103	400	10,000	1,000	97-103	100	1,000	100	95-103	90-103
16"	7,000	10,000	1,000	97-103	600	10,000	1,000	97-103	150	1,000	100	95-103	90-103

Current meters larger than 2" should preferably be tested in field by comparison with test meter.

Compound Meters***

Size	Maximum Rate: Rate in G.P.M.	Maximum Rate: Test Quantity Gals.	Maximum Rate: Test Quantity Ft.	Maximum Rate: *Accuracy Limits in %	Intermediate Rate: Rate in G.P.M.	Intermediate Rate: Test Quantity Gals.	Intermediate Rate: Test Quantity Ft.	Intermediate Rate: *Accuracy Limits in %	Minimum Rate: Rate in G.P.M.	Minimum Rate: Test Quantity Gals.	Minimum Rate: Test Quantity Ft.	Minimum Rate: Accuracy Limits in % *New Meters	Minimum Rate: Accuracy Limits in % **Repaired Meters
1-1/2"	80	1,000	100	97-103	15	100	10	97-103	1/4	10	1	95-103	90-103
2"	120	1,000	100	97-103	20	100	10	97-103	1/4	10	1	95-103	90-103
3"	250	1,000	100	97-103	30	100	10	97-103	1/2	10	1	95-103	90-103
4"	350	10,000	1,000	97-103	50	1,000	100	97-103	3/4	10	1	95-103	90-103
6"	700	10,000	1,000	97-103	100	1,000	100	97-103	1-1/2	100	10	95-103	90-103
8"	1,200	10,000	1,000	97-103	200	10,000	1,000	97-103	2	100	10	95-103	90-103
10"	1,600	10,000	1,000	97-103	300	10,000	1,000	97-103	4	100	10	95-103	90-103
12"	2,400	10,000	1,000	97-103	400	10,000	1,000	97-103	7	100	10	95-103	90-103

Compound meters larger than 2" should preferably be tested in field by comparison with test meter.

*Accuracy Limits recommended also for repaired meters.

**Tabulated minimum rate accuracy limits for repaired meters considered as those which can be achieved with most meters and good meter repair procedures.

**Any meter, regardless of age, which cannot be repaired to test 80% or better, on the minimum flow test should not be placed in service.

***Compound meters should also be tested at a rate within the "change-over" range of flows. As this range is variable depending on make of meter and sizes of bypass (or small) meter unit, no one set of definitive rates can be established. Minimum required accuracy at any rate within such "change-over" range of flows is 85%. The bypass (or small) meter unit of compound meters should also be tested at a rate as near as possible to the maximum test rate listed for disc meters of same size (without causing compounding valve to open). Accuracy limits on this test 98.5-101.5%. Specific rates cannot be readily tabulated for this test due to various makes of compound meters having different sizes of small meter units, and being designed for different rates of flow opening the compounding valve.

Recommended test specifications for water meters

For meters covered by AWWA Standard Specifications: C700-46, positive displacement meters; C701-47, current meters; C702-47, compound meters.

pair. All three rates are necessary to evaluate over-all meter accuracy.

The quantity of water used in a test should be such as to reduce testing errors to a minimum; it will depend on accuracy of test equipment and visual ability. Accuracy limits are established to insure that meters record as accurately as possible, recognizing that meters have an inherent variation of 2 to 3 per cent in registration over the whole flow range.

The committee set up three test specifications which they recommend as a supplement to the existing

AWWA Standard Specifications for cold water meters. The committee also suggested that these specifications (including accuracy limits for new meters on minimum flow) be used as standards for testing repaired meters. The committee does not consider that meter repair work is acceptable if any repaired meter, regardless of age, will not register at least 80 per cent on the minimum flow test.

Corrosion Research

Dr. T. E. Larson, Acting Chief, Ill. State Water Survey, Urbana, Ill., gave a research committee report on the "EFFECT OF WATER TREATMENT METHODS ON WATER MAIN CARRYING CAPACITY".

This study has been concerned principally with the loss of "C" value in coal-tar enamelled pipes carrying waters having chemical characteristics of the Great Lakes. Existing conditions were compared to special conditions resulting from treatment.

Among the findings to date: Free chlorine at 0.4 ppm enhances the corrosion of steel. When the velocity of water is increased, corrosion is lessened. The natural surface skin of cast iron resists corrosion, but when the pipe is ground the surface has less resistance to corrosion; unground surfaces are not attached even where there are holidays in the tar coating. A small amount of inhibitor in the water aids in preventing corrosion, as does a small deposition of calcium carbonate on the pipe. As little as 0.8 ppm of calcium in place of sodium at 125 ppm of alkalinity helps reduce corrosivity. Calcium silicate is found in 50 per cent of the tubercles. These studies are continuing under Dr. Larson's direction.

Hexavalent Chromium

C. F. Decker, Research Instructor, Michigan State University, East Lansing, Mich. reported on "TOXICITY STUDIES ON CADMIUM AND HEXAVALENT CHROMIUM IN PUBLIC WATER SUPPLIES." Studies were made on rats and dogs in reference to cadmium. Results indicated that the emitic property (ability to cause vomiting) appears to restrict the upper limit of cadmium to a value below 5 ppm. Significant accumulation of cadmium occurs in the liver and kidneys of rats ingesting water containing between 0.5 and 10.0 ppm of cadmium for a year but no gross evidence of pathology was observed at these levels.

Studies were made on the chronic toxicity to rats and dogs of hexavalent chromium in drinking water. Results indicate no difference in body weight, food consumption or water intake compared to control animals. Tissues from rats exposed for six months to one year showed no appreciable evidence of pathology. In animals' drinking water containing 15 to 25 ppm chromate, there were significant amounts of chromium in the kidney, liver, and bone, with the bone containing the largest amount per unit weight basis. Animals ingesting water containing less than 10 ppm of chromate showed little or no accumulation of chromium in the several tissues examined.

In some dogs, 15 to 25 ppm of chromate caused vomiting and retching when large amounts of water were ingested. Results to date with hexavalent chromium indicate that the maximum permissible level of chromium in drinking water must be less than 15 ppm of chromate. An experiment is now under way to evaluate the relative toxicity of hexavalent and tri-valent chromium.

Conformance to Standards

M. B. Cunningham, Director of Public Works, Oklahoma City, Okla. and AWWA Past Pres., reported for the General Policy Committee on the subject of "CONFORMANCE TO STANDARDS."

Mr. Cunningham commented on the situation wherein a manufacturer was producing valves on which there appeared the AWWA symbol although the valves do not conform to AWWA standards. AWWA has no control of such matters but has retained legal counsel to see what can be done.

In order to protect oneself against such misrepresentation, Mr. Cunningham suggested that water utilities should, (1) deal with manufacturers of good caliber and reputation and (2) accept the responsibility to inspect the equipment received or have the inspection done by the manufacturer or a commercial laboratory. Manufacturers will furnish certificates if requested.

Committee Reports

Logan Kerr, Consultant, gave a brief report for the Committee on Water Hammer, and called attention to the fact that there are two committees, one parallels the ASME Committee, the other consists of representation of AWWA on Committee B31 of the Amer. Stds. Assn. The ASA Committee has decided that its functions do not apply to water supply, therefore the AWWA Committee is now on its own.

The AWWA Committee has need of an item on pump stations and has set up a special Task Force Committee for allowances in distribution systems. Results of its analytical study will be reported in the future.

Arthur Price, Sen. Proj. Design Engr., Dept. of Water and Power, Los Angeles, Calif., reported for the Steel Pipe Committee. This committee is trying to improve specifications for lining steel pipe, with particular reference to coal-tar linings. New specifications are being developed for cement lining. Studies are being made of plastic linings with particular reference to the new family of baked-on applied plastic coatings. Other studies deal with asphalt versus coal tar enamels and the permeability factor of coatings.

Gerald E. Arnold, Gen. Supt., Water Dept., Philadelphia, Penna. spoke from the floor with suggestions that two different committees should take under consideration. First, the committee on meters should give consideration to (1) lowering head loss through the meter, (2) developing a standard register to avoid confusion and (3) reduce the number of digits in serial numbers on the meters by using a combination of letters and numbers.

Secondly, Mr. Arnold suggested that specifications for gate valves should be reviewed with respect to (a) stem diameters, (b) stuffing box follower gland and (c) protection of internal parts against corrosion.

Management And Resources Division

Two joint sessions were held by the Management and Resources Division. The first session* was devoted to a panel discussion of St. Louis Area Water Supply Developments, with C. M. Roos, Cons. Engr., Bellville, Ill., acting as moderator.

St. Louis Area

In discussing "WATER RESOURCES IN THE AREA" Mr. Roos described the several divisions of the sources of supply and stated that approximately 130 mgd of water is pumped to supply the metropolitan St. Louis area.

S. C. Casteel, Mgr., East St. Louis & Interurban Water Co., East St. Louis, Ill., spoke on "WATER RESOURCES DEVELOPMENT ON THE EAST SIDE OF THE MISSISSIPPI RIVER." He noted that 1955 data showed that 51 per cent of water pumped by his utility was used by industry. The supply serves approximately 350,000 persons and 100 mgd comes from the "American bottom area."

*Reported by L. W. Grayson, Ch. Engr. & Gen. Mgr., Public Service Dept., Glendale, Calif.

John B. Dean, Div. Engr., Supply & Purif. Sect., St. Louis Water Div., St. Louis, Mo., spoke on the "WATER DEVELOPMENTS OF THE CITY OF ST. LOUIS." The city uses both ground and surface water. The former has a rather constant temperature of 60° F while the temperature of the river water varies from 36 to 78° F. The river supplies 120 mgd, with the total peak capacity being 340 mgd. Present construction work will increase the capacity to 420 mgd.

W. V. Weir, Pres., St. Louis County Water Co., reviewed the "WATER RESOURCES DEVELOPMENT IN ST. LOUIS COUNTY". Little ground water is used. The surface supply problems include pollution of the river supply by industrial waste and raw sewage.

Of the 96 municipalities in St. Louis County, 92 are served by the company. The population served includes 126,000 as direct customers and 114,000 served through distributing agencies which buy the water from the company. Planned expansion by the company over the next 15 years is estimated at 75 mgd to meet service needs.

W. B. Schworm, Howard Bend Station, St. Louis Water Div., spoke on "WATER QUALITY AND TREATMENT REQUIREMENTS." He mentioned the wide variation of the water quality in raw water from surface supplies. The general trend of the Missouri River quality is toward a decrease in suspended solids. Water treatment includes softening from 260 ppm hardness to 100 ppm. Some ground waters have 3000 ppm hardness.

In the Howard Bend plant, chemical costs are $10.50 per mil gal and total treatment costs $94 per mil gal. Turbidity is reduced from 18,000-20,000 to 900 ppm before chemical treatment. Average turbidity today is about half of the previous average partly due to the 4-year drought period and partly to better regulation of river flows.

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C. M. Roos S. C. Casteel W. V. Weir W. B. Schworm

Second Joint Session*

"THE STATUS OF FEDERAL HIGHWAY LEGISLATION" and its provisions for the reimbursement of water utility relocation costs were reviewed by Harry E. Jordan, Secretary, AWWA.

The bill reported out by the House Public Works Committee retained substantially everything in the Senate Bill with some additions. This bill would provide for the reimbursement of 50 per cent of water utility relocation costs wherever such costs are borne by utilities and Federal funds are used in the highway construction.

Mr. Jordan urged AWWA members to support this legislation in the Senate through use of personal letters and other communications to their respective senators in Congress.

"THE NATION'S WATER RESOURCES" were reviewed by Assistant Secretary of the Interior, Fred G. Aandahl. Mr. Aandahl discussed the nation's water shortage problems, Federal research in the development of new water sources, and the report of the President's Advisory Committee on Water Resources Policy.

Present water shortages are attributed to a combination of population growth, air-conditioning, industrial growth, new technology, and increased requirements for agricultural purposes. Present daily water demand of 250 bil gal for all of these purposes is expected to be nearly doubled by 1975.

As a whole, the water supply picture for the nation is good. Local supply problems are expected, however, because the total available supply is so variable as to time, place, and quality.

The problem of water quality will become increasingly important, since our water supply must pass through more reuse cycles as the population grows and our economy expands. The immediate problem is that of providing the pumping, treating, and transmission facilities required to utilize water from existing sources.

The importance of basic data activities of the various Federal agencies was emphasized. Rational planning for future water supplies requires all possible information about existing and potential water supply sources. Collecting and analyzing basic data are both time-consuming and costly tasks, but to proceed without this information could be far more costly and even tragic.

Federal studies currently underway include phreatophyte control, effect of various forest management practices on snow retention and runoff, artificial recharge of ground-water reservoirs, artificially induced precipitation, control of evaporation losses from reservoirs, and salt water conversion.

The water resources policy of the present administration is one of partnership between Federal, state, and local participants in the solution of water supply problems.

The Report of the Presidential Advisory Committee on Water Resources Policy was reviewed. This report emphasizes that there is no "national" water problem, but there are a variety of water problems which are unique in each region, state, and locality. The report stated that there can be no over-all plan for water resource development; planning must be based on existing and projected conditions in each area.

The Committee proposed that regional or river basin committees should participate in coordinating all planning activities.

The Committee also proposed: (1) An office of Coordinator of Water Resources be established in the Executive Office of the President; (2) the Coordinator to reconcile interagency differences, establish uniform procedures for all agencies, evaluate departmental requests for appropiations, reconcile policy differences, and prepare long-range programs of water resource development; (3) an impartial Board of Review to evaluate the economic and engineering feasibility of projects and prevent "pork barrel" legislation before submittal to the President; (4) all agencies prepare project evaluations on a uniform basis and that all costs, including interest and taxes, be included in project evaluations; (5) If there is to be a genuine partnership in the water resources development field, state and

*This and following sessions were reported by David H. Howells, Sen. San. Engr. U. S. Pub. Health Service, Chicago, Ill.

local interests should be expected to assume a fair share of the costs along with their increased responsibility; and (6) the share of the costs to be borne by the beneficiaries should be proportionate to the benefits received while the Federal government should bear that portion of the cost of a non-Federal project which is deemed in the national interest.

Effects of Dams on the Missouri

"THE MISSOURI RIVER" was the subject of a panel discussion of the effect of the Federal construction program upon the quantity and quality of water in the Missouri Basin. John W. Cramer, Fulton and Cramer, Consulting Engineers, Lincoln, Nebraska, was the moderator.

The Corps of Engineers story was presented by Wendell E. Johnson, Chief, Engng. Div., Missouri River Div., Omaha, Neb., who discussed the effects upon the total river flow of present and probable future operation of main-stem dams.

The multiple-purpose approach of the Pick-Sloan plan was said to have made possible an integrated and comprehensive program for the Missouri Basin through which all interests and areas of the basin could be adequately served.

In the decade since construction of the Pick-Sloan program began, water supply as an independent and important factor in its own right, has become a very significant element of basin planning. Many national leaders in the field of water resources, including the Chief, Corps of Engineers, are now advocating that water supply for consumptive use should be a specific requirement for any comprehensive river control program.

The upper Missouri Basin program includes a number of tributary reservoirs which are designed primarily to store water for irrigation and power development. About nine of these have been completed, or are under construction, and about forty-five remain to be started.

The backbone of the entire program is the main-stem reservoir system located in Eastern Montana and the Dakotas including six major reservoirs with a combined storage capacity of 73,500,000 acre-feet, which is nearly three times the average annual flow of the Missouri at Sioux City. These reservoirs will ultimately create a chain of inland lakes stretching in almost continuous line for over 800 miles along the Missouri. The degree of control which they will afford has no counterpart in the world, except the contemplated development of the Nile in Africa, and the planned program on the Colorado River.

These reservoirs will serve for flood control, pollution abatement, irrigation, navigation, and hydroelectric power and will provide attractive lakes as recreation centers for a large area.

In the lower basin, the program includes a number of tributary reservoirs, primarily for flood control. Along the main stem of the Missouri from Sioux City to the mouth, a program of bank stabilization has been underway for many years. Virtually every waterworks installation along the Missouri River below Sioux City is located on a site protected by such stabilization works. The confinement of the channel will provide a nine-foot navigation channel from Sioux City to the mouth, connecting with the great inland waterway system.

Program benefits gained include: a high degree of flood control; placing of 68,400 acres of land under irrigation; increases in navigation from 52,000 tons in 1952 to 415,000 tons in 1955; power generation of 1.2 billion KW hours (in 1955); smoothing out of river flows to assure adequate public and industrial water supplies; and increased flows for water pollution control. The reservoir program has substantially reduced turbidity and "averaged out" the hardness, thus simplifying the task of water treatment.

"RECENT CHANGES AND TRENDS IN QUANTITY AND QUALITY OF MISSOURI RIVER WATER" and of ground water in the immediate vicinity of the river, were set forth by George E. Ferguson, Engineer, U. S. Geol. Sur., Washington, D. C.

Because of the magnitude of the Missouri River Basin program, the hydrology of the basin will undergo significant changes. Many additional water facts will be required, however, to define the future pattern of stream flow and occurrence of ground water adjacent to stream channels, and the changes of quality in each.

Current changes reflect only the early stages of transition to a rather fully controlled Missouri River. It is expected that changes, such as the flow pattern of the main river, will be comparatively great. Other changes, as in the chemical quality of the river water, are likely to be less severe. Ground water tables adjacent to the River will reach a new point of stabilization in relation to the new patterns of river levels.

"PRESENT CONDITIONS AND TRENDS IN RESPECT TO POLLUTION OF THE MISSOURI RIVER" were discussed by Dwight F. Metzler, Chief Engr., Kansas State Board of Health, Lawrence, Kan.

Pollution of the Missouri River has been of great concern to public health authorities and to cities using it as a source of public water supply for many years. First study of this problem was made by the Public Health Service in 1913, at the request of the Kansas State Health Officer. Concern engendered at that early date has increased with the growth of cities and industries and the accompanying increase in waste load.

A joint study of the Missouri River by the states of South Dakota, Nebraska, Iowa, Kansas, and Missouri, was completed in 1952, with the assistance of the Public Health Service. This study revealed serious bacterial pollution and excessive organic pollution in some stream reaches. Two-hundred and seventy municipal sewer systems are tributary to the lower Missouri River. These serve a population of 1,400,000. Industrial wastes discharged are equivalent to a population of 3,190,000 persons.

Coliform densities vary from 2,300 coliform organisms per 100 ml at Yankton, S. D., to nearly 100,000 at Sioux City, and remain above 30,000 to a point well below Jefferson City, Missouri.

An example of the effect of upstream pollution upon raw water quality is provided at Kansas City, Kan., where the average annual coliform concentration increased from 6,000 to

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H. E. Jordan | Geo. E. Ferguson | J. C. Detweiler | J. B. Ramsey

73,000 in a thirty year period.

Because the safe limits of coliform loading were being exceeded at the water purification plants in four downstream states, the five state health departments and the Public Health Service agreed to a cooperative uniform program of pollution abatement for the Missouri River below Fort Randall Reservoir. It was agreed that each state had primary responsibility for abating the pollution within its boundaries, and that this action should be carried out under the widely varying laws of the individual states rather than through Federal enforcement. In the event that joint State-Federal progress reviews indicate that the reduction of pollution in a particular state is lagging seriously behind progress in the other states, the Public Health Service would be requested to initiate Federal enforcement proceedings.

The five states are implementing their program for cleaning up the Missouri River through regular conferences with officials of the Missouri River Cities. Jan. 1, 1959, has been set as the date for each city to start construction of primary treatment facilities. This major program will cost about $100 million and will take considerable time to finance.

The full effect of river development and regulation is yet to be determined, but the reservoir releases to date for navigation during the warm months have not given the benefit in reduced bacterial content, which might have been expected from increased dilution.

"Experiences and Observations of the Water Utility Executive," as to the effect of the Missouri River program on the water supply of Omaha were presented by John C. Detweiler, Gen. Supt., Water Operation, Metro. Util. Dist., Omaha.

Omaha is the first large city forcing its water supply from the Missouri River below the main-stem reservoirs. Prior to the river development program, certain hazards were experienced in the use of this water supply source. These included occasional deficiencies in water quantity, floods, high turbidities, and high mineral content during low-flow periods.

The general effect of the Missouri River improvement program on the Omaha water supply has been the development of a stabilized channel, flow regulation, the practical elimination of the flood hazard, improvements in raw water quality (lower peak and average raw water turbidities, and improved taste and order).

"The Effect of Main Stem Dams of the Missouri on Kansas City's Water Supply was reviewed by James B. Ramsey, Chief Engr. and Supt., Water Dept., Kansas City, Mo.

Had it not been for the supplemental flows provided by the reservoir system, Kansas City would have experienced prolonged water shortages during the last three drought-ridden summers. The discharges from the reservoirs and resultant higher river stages made it possible to meet a 57 per cent increase in maximum-day consumption in recent years.

Kansas City has also benefited from the river control measures through lowered turbidities and a dramatic reduction in coliform densities.

Water Works Management Division

In addition to two joint sessions with the Resources Division, the Management Division held two other sessions. At the first of these sessions Samuel S. Baxter, Water Commissioner, City of Philadelphia, described the "Management Reorganization of the Philadelphia Water Department."

Until recently water service in Philadelphia had been operated as a bureau in the organization structure of the city government. Its expenditures were paid from the general fund as were other governmental expenditures; revenues from water rents were deposited in the general fund as part of overall income. Severe pollution of the city's raw water source, together with deterioration of treatment plants, pumping stations and distribution system presented acute problems by the late 1940's. In many years income from water rents exceeded costs, but since all of the money went into the general fund, much was diverted which should have been used in modernizing plant and equipment.

A new city charter, enacted in 1952, gives the Water Department both the power and duty: to operate the city's water supply system; to construct new facilities; to operate the sewer system and sewage disposal plants, to construct new sewage works facilities; to fix and regulate rates for water and sewage services (subject only to standards which the Council might fix); and to include in operating expenses services performed for the Water Department by other departments.

Under the new charter the Water Department became one of ten service departments which are under the control of a Managing Director who, in turn, is responsible to the Mayor. The new Water Department is organized into four basic units. These are the Water Operations Division, Sewage Operations Division, Engineering Bureau, and Administrative Division. The directors of each unit are responsible to the Commissioner of the Water Department.

One outstanding step in the reorganization has been the creation of a separate water fund and a separate sewer fund which are entirely distinct from the general fund of the city. All costs of the operation of the Water Department must come from monies in the water and sewer funds, and all revenues from water and sewer rents and other charges are deposited in the water and sewer funds.

Income includes not only regular charges from customers for water service, but also a charge payable from the general fund to the water fund for water furnished to city buildings, and a charge per hydrant for fire fighting costs. It also includes an amount payable from the general fund to the water fund for the direct cost of the high pressure fire-fighting system which is operated by the Water Department. Conversely, the water fund pays into the general fund a proportionate cost of the operation of other departments which furnish service or have general supervision over the Water Department.

To overcome the problem of no modern water works accounting system, a new cost accounting system based on the standard AWWA manual was installed. This system was essential to the organization of the Philadelphia Water Department on a sound utility basis.

An entirely new basis for customer relations had to be established and a new Customer Service Division was organized. Persons who telephone for information or call at the office are handled by an employee who stays with the customer until the matter is settled. Complaints or requests for information which need field investigation are handled promptly by uniformed inspectors most of whom travel in radio-equipped cars.

Full recognition was given to the problem of modernizing and rebuilding the physical plant. At Torresdale a new rapid sand treatment plant of 423 mgd. capacity is now under construction and will replace the old slow sand plant at this location. At Queen Lane the 120 mgd plant is being reconstructed and modernized. Design work is now starting for the construction of modern rapid sand filters at the Belmont plant which will raise its capacity to 85 mgd. When all three of these plants are finished and the small 25 mgd. plant at Roxborough abandoned, Philadelphia will

have completely new rapid sand treatment plants for its entire water supply.

One step taken to help in design and re-design of the distribution system has been the purchase of a McIlroy Fluid Network Analyzer.

Another important phase of the operation was adoption of a universal metering program for the 180,000 unmetered services. Extensive litigation delayed the program until 1955. It will be completed by the end of 1956.

One real problem in the overall reorganization was the matter of meter reading and billing. This responsibility was placed in a separate department by the charter and the necessary changes have not been made to modernize this function. The Water Department believes that the full and final solution is to transfer functions of meter reading and billing to the Water Department.

In the discussion which followed this paper, Frank Baldwin, Dir. of Util., Houston, Texas, asked whether the cost of services performed for the Water Department by other departments of the City and charges payable from the general fund for water furnished city buildings and for fire fighting balanced one another. The answer was "not necessarily."

Arthur Rynders, Ass't City Engineer, Milwaukee, Wis., asked whether the Water Department pays a tax to the City. The answer was "no".

Linn Enslow, Editor, *Water & Sewage Works,* asked how the problem of taking over privately owned meters was handled. Mr. Baxter said that the word "title" was ducked and the judge ruled that meters had to be furnished by customers as a necessary means for measuring water provided by the city.

Mr. Enslow also asked about the handling of billing complaints by the Water Department when collections are handled by a separate department, the reply being that the Water Department follows through on all complaints.

Meter Program

"PHILADELPHIA'S WATER METERING PROGRAM" was described by G. E. Arnold, General Supt., Philadelphia Water Department. He dealt with both the universal metering program and the reorganization of the meter repair shop.

The first step in Philadelphia's universal metering program was to set up an organization to review the records and establish the procedure to be followed. From the billing records in the Department of Collections, the name and address of the owner of every unmetered premise in the city was obtained and file cards prepared.

The next step was to establish a pre-inspection routine for all of the unmetered properties. A pre-inspection form was prepared for use by the inspector when the pre-inspection was made. The pre-inspection served several useful purposes: (1) It notified the owner or occupant in person that he would be required to install a water meter and gave him an opportunity to ask questions which could be answered by the inspector; (2) it gave the department a complete record of the size, type, and condition of the piping in which the meter was to be installed; (3) it gave the department and the owner information regarding any repiping which had to be done as part of the meter installation; (4) the inspector hung a red tag on the piping at the point where the meter was to be installed.

Property owners were given the choice of having their own plumbers install the necessary fittings and connections for the water meter, or by returning their copy of the inspection report they could indicate that they desired the City to do the work under contract at their expense.

A special type of horn or yoke for meter installation was developed by the Department and manufactured to its specifications. This unit is similar to the standard horn except it is equipped with compression couplings which permit the horn to be installed on existing piping without threading the pipe, or soldering in the case of copper tubing. This enabled the installations to be quickly and economically made. Meters were installed and set by employees of the Water Department.

Financing of the universal metering program was done through a bond issue. The bond fund was used to purchase the meters and make the installation, the total cost of which was charged to the property owners, who reimbursed the Water Department for the full cost. Because all meters installed in Philadelphia prior to the universal metering program had been bought and paid for by the property owners, the only equitable way to handle universal metering was to have all new meters installed at the customers' expense. Upon completion of the installation, a bill is prepared and presented to the property owner which he may pay within thirty days or in three equal installments over a period of two years. A charge of 6 per cent is made on deferred payments. Cost of a standard installation including the pre-inspection, overhead, horn, labor, and a meter is about $35.

An entirely new concept of water meter repair was instituted about three years ago in Philadelphia and has resulted in a vast increase in the number of meters repaired, without increase in the number of persons required to do the work and at a considerable reduction in overall cost.

Management Division

S. S. Baxter G. E. Arnold Went. Smith

In 1952 there were more than 30,000 meters still in service on consumers' piping which were known to be in poor condition. Most of these had been reported as non-registering meters by meter readers. In addition, there were about 5,000 meters in the meter shop awaiting repair, and being repaired at the rate of about 400 a week. Each repairman in the shop customarily handled one meter at a time, doing the entire cleaning and repairing operation himself.

Late in 1952 a firm of industrial consultants reviewed the operation of the meter shop and recommended improvements. Following their survey, the meter shop was completely reorganized, new equipment purchased, the employees placed on an incenitve pay plan, and overall operations materially increased.

Meters now move through the shop on a production line basis. No one has to carry a water meter more than five or ten feet in the shop. Meters move from one step in the process to another by gravity conveyors, each meter being kept to itself in its steel pan. Each step in the

operation is performed by one man, especially trained and qualified for that step. The meter repair shop now runs more than 1,400 meters a week through the shop with the same total number of employees who used to run 400 through in the same period.

Incentive Plan

One of the important developments in connection with the meter repair shop is the establishment of the incentive pay plan. Time studies were carefully made of each operation in the shop and a standard established for that operation. Each man receives his base pay whether he performs in accordance with the full standard or not. If the repairman exceeds the standard, he receives additional pay in accordance with the standard time prescribed for each operation. Thus, by working diligently at his job, the repairman is able to earn additional pay.

Since all of the operations are on a production line basis, all of the men in the line lose at least a portion of their incentive pay if one of the men in the line does not do his full share of the repair work. This has been instrumental in increasing the rate of operation in the shop and is as responsible for the marked increase in production as the new equipment.

The labor union and Civil Service Commission approved the incentive pay plan after some persuasion. Union approval was obtained because the plan guaranteed a minimum wage on a day by day basis, whether or not the man meets the minimum standards.

Field installers also work on the incentive pay plan and are given certain time credits for each field operation. They even get credit for a no-response when there is no one home and the work cannot be done. A reasonable allowance is made for driving time from one job to another.

In 1954, a rotation schedule was established under which all meters will be brought into the shop for repair at least once in ten years. It is felt that this rotation schedule will result in better metering of the water and a definite increase in revenue.

During the discussion which followed this paper, E. Arthur Bell, Chief Engr., Stamford Water Co., Stamford, Conn., asked whether Philadelphia had investigated the use of sand blasting as a substitute for acid in meter cleaning. Mr. Arnold replied that they have not found an entirely satisfactory answer to this problem, but that acid is the best so far.

Linn Enslow, Editor, *Water & Sewage Works*, remarked that Philadelphia's incentive pay plan is unique in water works history and asked if anyone present knew of another instance. No one present knew of any. Then Mr. Enslow asked about application of the incentive pay plan to other employees in the metering division. No, only routine meter repair and test operations have been placed under the incentive pay plan.

Another question referred to the practice of replacement of both small and large meters. Mr. Arnold said that when any meter is removed it is replaced by a new or reconditioned meter which is left in place as a permanent replacement. This practice requires only one trip to the point of installation as contrasted to two trips for a substitute meter.

In his paper "How Meters Affect Revenue", Wentworth Smith, Neptune Meter Company, New York, N. Y., credited meters with providing a practical means for making the water works a self-sustaining industry and likewise "stretching" presently short water supply through waste prevention.

One basic reason given for metering is that it provides good data as to water produced, delivered and unaccounted for. Metering reduces waste and can be considered a conservative measure. Metering of previously non-metered communities is a revenue producing measure and results in immediate financial benefits. Universal metering makes scientific cost accounting procedures possible.

Metered water use provides a sound base for sewer use charges and helps to place sewage collection and disposal on a self-sustaining basis.

In raising bond issues for the expansion of a water system, metering will help to lower interest rates.

Many examples of water conservation and increased revenue through metering were cited in detail by Mr. Smith.

"The Water Demand Potential of Irrigation in Humid Areas" was the topic of a paper by John R. Davis, Asst. Prof. Agricultural Engineering, Purdue University.

The use of supplemental irrigation in the 31 Eastern humid states was said to be increasing at an average of 5,000 acres of irrigated land per year per state.

Irrigation produces a huge increase in net return per acre. Proper design can give still further increases in yields with an accompanying decrease in water requirements. Supplemental irrigation is a very effective tool for the elimination of risk from erratic rainfall.

Several factors to be considered in any consideration of water requirements for supplemental irrigation are: (1) irrigation water is, in general, entirely consumed; (2) the water demand for irrigation is a direct function of the available supply; and (3) the ultimate feasibility of supplemental irrigation is dependent, to a certain extent, upon water quality.

Irrigation was pictured as a tool for use to increase our standard of living. According to the speaker, we must plan for it, and learn to live with it.

"The Evaluation of Weather Modification Experiments" was reported by F.A. Berry, Chief Scientific Adviser, Advisory Committee on Weather Control, Washington, D. C.

Mr. Berry reported that only 5 to 15 per cent of the available moisture in clouds is utilized by rainfall through the natural processes of ice crystal formation and coalescence.

Artificial rainmaking makes use of nuclear formers such as silver iodide. A sub-cooled cloud system is required and the resulting precipitation is extremely variable. To evaluate properly the effect of cloud seeding, we must deal with long term averages.

Over a five-year period, the runoff from controlled study projects has been found to increase by 10 per cent because of cloud seeding. In 4 West-Coast projects the increase ranged from 9 to 18 per cent while, in 3 others there was no noticeable change in runoff.

The Advisory Committee feels that much more work must be done before it can predict the successful use of cloud seeding in warmer areas.

Cloud seeding is not a cure for drought and can only effect rainfall where it occurs naturally. It is not a substitute reservoir for irrigation. The increases obtainable under the most favorable conditions would not exceed 10 to 15 per cent. The question to be considered now, is not whether cloud seeding will work, but how well it will work.

The discussion of this paper included questions regarding seeding methods, the effect of increased reservoir areas on precipitation, and the effect of cloud seeding on hurricanes. It was reported that cloud seeding has been performed almost entirely from the ground in the controlled experiments. The additional evaporation from ever-increasing reservoir areas is not expected to have any appreciable effect on rainfall. Mr. Berry indicated that cloud seeding experiments dealing with the control of hurricanes are fraught with danger, but the matter is currently under study.

The Impact of New Industry on Water Supply and Pollution *

by B. A. POOLE

Mr. Poole is Chief Engineer of the State Board of Health and Technical Secretary of the Stream Pollution Control Board of the State of Indiana. In this article he discusses the important subject of industrial development as it affects water supplies and waste treatment.

OUR RAPID increase in population in the last few years, our increased standard of living, the phenomenal expansion of industry, the increased crop yields as a result of supplemental irrigation and the droughts of recent years have all contributed to the realization that water will play the predominant role in the economy of the state of Indiana in the next fifty years. Contrary to popular opinion we still have about as much water as we always had. Its use, however, has intensified to such an extent that we must develop what we have and properly manage it if future generations are to be unhampered in its use.

Public Water Supplies

It is a known fact that some Indiana municipalities, particularly in southern Indiana, cannot continue to expand or for that matter cannot attract a single water-using industry until additional sources of water are developed. It is also well known that much of southern Indiana has no ground water to develop. And the supply is by no means unlimited in many other portions of the state. Fortunately we have plenty of rain and there are few localities where an impoundment can't be made at a reasonable cost. We have no insurmountable water supply problem. All we need to do is store some of our flood flows and release them when we need them.

There are 397 Indiana municipalities served by public water supplies that come from 360 sources. These supplies serve 2,500,000 people. In 1953, 60 of these sources experienced shortages of one kind or another, most of them due to inadequate supplies. Some difficulties were caused by inadequate pumping or purification works, inadequate storage of finished water or undersized mains. Forty of the 60 have made improvements. Some of these are good for a long time even with sizable expansion. Others won't accommodate five years of normal growth. In addition to the 60 that had difficulty in 1953 we have another 60 small towns limping along on only one well. And in a few of these the attitude prevails that the pump on this well will run forever!

Droughts are almost invariably blamed for water shortages, with little thought given to increased consumption although it is usually the real offender. The population of Indiana is increasing 60,000 to 80,000 each year, and water consumption is going up at a rate of 2.1 gallons per person per year. In cities above 100,000 water use is increasing at a rate of 3.3 gallons per capita per year. By 1975 the average daily per capita consumption will be 210 gallons in these cities and 330 gallons per person will be required on the maximum day! In cities between 25,000 and 100,000 the per capita per day increase is 2.3 gallons each year. By 1975 these cities will require an average of at least 190 gal per capita per day. On the maximum day they will require 250 gal per capita. In cities between 2,500 and 25,000 the per capita per day increase is 1.9 gallons each year. In 20 years they will require about 150 gallons per capita per day.

Between 1940 and 1954 the total daily water consumption increased from 198 to 332 mgd. This is an average increase of 5 per cent per year. Obviously a "live" city must plan on more.

While the increase in municipal water consumption has been phenomenal, municipal use is small compared to our industrial use. U. S. Department of Commerce figures for 1953 (Water Use in Manufacturing—Series: MAS-53-3—USDC.) indicate average daily industrial consumption for the state was about two billion gallons. Four and three tenths per cent of this is covered in the municipal figures. The rest comes from industrial supplies. This same report lists the following industries as the top water users as shown below. Other low water users are furniture, printing and publishing, transportation equipment, instruments, machinery and fabricated metals.

These statistics are worth remembering by anyone interested in industrial location. No industry, which will become an asset to a community, is going to locate there until it is assured of an adequate water supply, either from the public water system, or through its own development. If it is willing to develop its own source it will expect an adequate supply of pure, potable water in the homes of its workers.

Wastes

When we put water under pressure we create waste disposal problems. Increased domestic water consumption means more sewage. There are few industries that don't have some

Blast furnaces	24	mil	gal	per	yr	per	employee
Electrometallurgical	22	"	"	"	"	"	"
Alkalies & chlorine	17	"	"	"	"	"	"
Organic chemicals	14	"	"	"	"	"	"
Pulp mills	12	"	"	"	"	"	"
Petroleum refining	11	"	"	"	"	"	"
The lowest water users were:							
Aircraft industry	0.03	"	"	"	"	"	"
Telephone & telegraph equipment	0.05	"	"	"	"	"	"

*Presented before the Industrial Development Conference at Purdue University, Mar 19, 1955.

liquid industrial waste. The volume depends on the type of industry. The difficulties in properly handling it depend on the volume and the characteristics of the waste. Cooling water from an ordinary steam generating plant is harmless and produces no ill effects other than possible temperature increases. In contradistinction a nuclear power plant will create wastes many times more toxic than anything ever encountered by man. A meat packing plant produces organic wastes several times as potent as human sewage.

Liquid waste disposal problems fall into two main categories:

1. Getting the wastes away from the establishment, whether it it is a home or a factory building.
2. Changing the characteristics of the wastes so they will not unduly jeopardize any beneficial water use.

With industrial development in any community there is always an accompanying housing development either inside the community or immediately adjacent to it. Housing and population development also present problems of water supply and waste disposal and are therefore worthy of comment.

Sewers

As in the case of public water supply improvements the State Board of Health has worked with cities and towns on sewerage developments for many years. Approval of plans and specifications in both categories is required before construction begins.

Experience has shown that the individual septic tank and absorption system is a very poor substitute for community sewers and sewage treatment. It is expensive, costing about $500 per residence. In many areas of the state it will not give satisfactory performance more than two or three where it will work as long as ten years. There are few areas indeed years without a major overhaul. Consequently, the State Board of Health will not approve individual septic tanks and absorption systems for community type housing developments until all possibilities of a common sewer system have been exhausted.

There is much community housing underway in Indiana that is beyond the reach of the municipal sewers. Wise planning and zoning with firm enforcement of local plans would prevent some of this development, and eliminate many future headaches. This is a local prerogative that isn't assumed in many localities. Where connection to city sewers cannot be made, the State Board of Health requires a community sewer system and a single sewer treatment plant where practicable. The only way maintenance and operation of the system can be assured is through the establishment of some type of trust agreement. Even with these there are many headaches ahead since the operation of small sewage treatment works is conducive to headaches. The Indiana Home Builders Association is currently involved in an attempt to frame legislation to make it easier to establish a responsible agency for the maintenance and operation of community sewerage systems. The home builders are conscientious in their efforts and deserve the support of city officials, Chambers of Commerce, etc.

Extension of city and town sewer systems into the suburbs is the only satisfactory answer to the problem. The two most common stumbling blocks are the inability to finance and trunk sewers that are too small for the additional load. The latter problem can be solved sometimes by requiring the new addition to put in separate, instead of combined, sewers.

Within recent years there have been several laws enacted which simplify the financing problem. Some of these are:

a. A supplement to the sewer service charge act now permits the issuance of revenue bonds to finance local sewers and the levying of a connection charge on the properties served by these sewers. The sewer service charge and revenue bond act is the law used almost exclusively to finance municipal sewage treatment works. Works financed under the law may be constructed inside and outside the corporate limits. However, since it is the intent of the law to provide a means of financing the disposal of a municipality's sewage, the sewage of a subdivision outside the corporate limits must be brought to the city's sewers through works financed by the developer or the area must be annexed to the city. (Sec. 48-4301 et seq; Supplemental act, Sec. 48-4339, Burns Indiana Statutes—1950 Replacement)

b. A law enacted in 1949 as a supplement to the Barrett Law (Indiana's Special Assessment Law) improves the ability of cities to finance local sewers by the special assessment method. The city council may by ordinance declare the percentage of the cost of the sewer project that is of general benefit to the city and particular benefit to the property owners served. The city assumes the primary responsibility for the full payment of principal and interest of the bonds issued to finance the project. Since the contractor is paid in cash the disadvantages of payment in Barrett Law bonds are eliminated. (Sections 48-4431 and 48-4432, Burns Indiana Statutes—1950 Replacement)

c. A 1955 act permits contracts with owners or lessees of property in the vicinity of cities for the provision of municipal services. In return for such services the city receives payments in lieu of taxes. The contracts may run for 15 years in first and second class cities and for four years in the case of others. This permits a city to provide sewer service to an industry, or to a housing developer. (Section 48-701, Burns Indiana Statutes—1955 Cumulative Pocket Supplement)

d. Another 1955 act permits any Board of Works to contract with any owner of real estate within four miles of the corporate limits for the construction of sewers, pumping stations and sewage treatment works. The contract must contain a release of the right to remonstrate against annexation. The important feature is that the party who pays for the original works may be reimbursed by anyone who connects to the system within 15 years. (Section 48-3938, Burns Indiana Statutes—1955 Cumulative Pocket Supplement)

Sewage And Waste Treatment

Waste treatment is supervised by the Stream Pollution Control Board. The work of the Board is done by engineers of the State Board of Health. Its program is based on three essential principles:

1. Prohibit new sources of pollution. The Board does not approve plans for new sewer systems or new industrial waste outlets unless adequate treatment is provided.
2. The elimination of existing pollution.
3. Utilization of receiving waters for the assimilation of treated sewage and industrial waste as long as it does not interfere with any other beneficial water use.

The other states in the Great Lakes Region and the Ohio Basin are enforcing essentially the same type of program.

Municipal Sewage

At present better than 80 per cent of all the sewered population of Indiana is connected to sewage treatment plants. As might be expected the percentage of larger municipalities having sewage treatment plants is much greater than the percentage of the towns, since the Board's program of the last several years has been directed primarily to the larger sources of pollution.

Currently some cities with a population of more than 10,000 have overloaded sewage treatment works; others are nearing capacity. Many still require extensive relief sewer work; seven have no treatment plants at all. The problem of the future resolves itself into expanding sewage treatment works and relieving overloaded sewers.

In the 2,500 to 10,000 population bracket there are 45 cities with sewage treatment plants and 26 municipalities without them. Ten of the existing treatment plants are over-

loaded. Sewers in the smaller municipalities may not cover the entire town, hence the problem of these cities in the future is three-fold: (1) Extension of sewers. (2) enlargement of sewage treatment plants, and (3) installation of sewage treatment plants where they are not available.

There are 35 cities and towns in Indiana with a population less than 2,500 that have sewers and sewage treatment. In this population bracket there are 118 municipalities with sewers and no sewage treatment. In many cases sewers in these areas may serve only 50 to 60 per cent of the town. Hence, their problem resolves itself into rounding out the sewer system and the installation of sewage treatment works.

Industrial Wastes in City Sewers

The matter of handling industrial waste in municipal sewer systems and municipal sewage treatment works is one which deserves careful attention. While the Stream Pollution Control Board recognizes this is a matter which must be settled at the local level, it has some definite views on the subject. As a general policy the Board prefers to see industrial waste handled at municipal sewage treatment plants, *if this can be done without jeopardizing the treatment plant or the stream.* It prefers this approach since experience has indicated that some sewage and industrial waste treatment works are not consistently operated at peak efficiency. And the fewer treatment plants you have the fewer there are to cause trouble. Consequently in the case of any new industrial location the Board will ask that the possibilities of connection to city sewers be explored before industrial waste treatment facilities are designed if it appears that the quantity and characteristics of the industrial waste are amenable to treatment in the city sewage treatment plant. Obviously there is no rule of thumb or standard criterion for a problem of this sort. Each case must be treated individually.

Policies within the cities and towns on the handling of industrial waste vary widely. Some city officials go overboard and are willing to accept any and all industrial waste. Others lean as far in the other direction and don't want anything.

We quite frequently find city officials do not work closely enough with industry in the early stages of industrial plant location. An industry will receive a promise the city will take care of its waste. Then it will learn the city was thinking only of sanitary sewage and is not in a position to handle industrial wastes. In many cases, sewers near the industrial site may be too small. But it is frequently cheaper to build some sewers than to build elaborate industrial waste treatment works. In some cases separation of cooling water may be all that is needed. Basically it is sound practice to consider a minimum of two, and in many instances three, sewer systems within an industrial establishment.

The fact that a city sewage treatment plant is near its rated capacity does not necessarily mean a city should not take on a sizable amount of industrial waste. Like all other things associated with mass production a gallon of sewage or waste can be treated for less money in a large plant than in a small plant. Consequently, it may be to the advantage of both parties to expand the city sewage treatment plant rather than build a separate industrial waste treatment plant. Obviously the industry should pay its just share of the cost of expansion. This will usually be cheaper for the industry than its own treatment works would be.

Separate Industrial Waste Treatment

There are many industries which produce such large volumes of waste that they cannot be handled in a municipal treatment plant. Examples are the primary metal industries (65,000 gallons of water per ton of steel); petroleum refineries (18 gal of water per gal of oil); pulp mills; distilleries; chemical plants; large meat and vegetable packers; and large milk plants. Since many of these industries produce very strong wastes, and a few of them toxic wastes, they are also restricted in location to sites accessible to large streams in order to keep the cost of treatment from becoming prohibitive.

The polluting effects of the majority of these wastes are due to their organic constituents. It is organic material that usually uses up the oxygen in a stream, thereby causing it to become black, foul-smelling and unfit for livestock or fish life. Treatment processes will remove from 30 to 95 per cent of the organic material in waste so the amount of dilution water in the stream determines the degree of treatment that is required. Since no treatment process removes 100 per cent of the organic material we cannot expect satisfactory conditions in a small stream which receives large quantities of even highly treated wastes.

The development of nuclear reactors will bring us face to face with the most toxic material ever handled by man. Unlike other pollutants you can't kill radioactivity by chemical or biological treatment. All that can be done with the intermediate and high level wastes is concentrate them and hold them in safe keeping until natural radioactive decay makes them harmless. In the case of a few elements this is a matter of a few hundred years! Some of the low level wastes, with relatively short half-life, can be held for short periods to permit some natural decay and then be disposed of by dilution. This, plus the large quantities of water usually needed for cooling, pretty well fixes the location of large reactors to sites on large streams.

Considerations Of Importance

Space will not permit a complete dissertation on the handling of industrial wastes. They must be properly handled if we are to preserve Indiana's waters for future generations. All persons involved in industrial plant location should keep the following items in mind:

1. Industries that produce large quantities of waste, or have highly potent wastes, should locate on large bodies of water.

2. The uses to which water are put downstream from an industrial outlet have an important bearing on the degree of treatment required. Example—greater quantities of taste-producing compounds may go into a river downstream from a water works intake than into the same river above the intake.

3. Areas where water supply is short, or where summer stream flows are low, should look for industries which produce small quantities of wastes.

4. The Stream Pollution Control Board should be consulted before industrial sites are definitely chosen in the case of all industries that produce wastes in quantity. We will keep the information confidential. Sometimes a given industry can be easily accommodated on one side of town whereas location on the other will bring on exorbitant waste disposal costs.

RAFT LAYING team at work. Note relative position of cetyl alcohol pellet rafts

Cetyl Alcohol Controls Evaporation

Experiments at Kenya, So. Africa indicate reservoir evaporation losses can be reduced.

KENYA, LAND of recurrent water problems, is misting its reservoirs and dams with a molecule-thick film of a chemical fr[illegible] the sperm-whale in a larg[illegible] attempt to save millions of gallons of water from evaporation each year.

by HAROLD C. LAYCOCK

Mr. Laycock was, at the time of writing this article, Information Officer on the staff of the Dept. of Information, Nairobi, Kenya, So. Afr. He is now in the United Kingdom Information Services in Accra, Gold Coast, South Africa. In this article he describes the anti-evaporation experiments to curb Kenya's water losses.

CETYL Alcohol pellets in evaporation pan

Patterned on similar trials by the Commonwealth Scientific and Industrial Research Council in Melbourne, the East African Meterological Department has begun the world's second experiment to launch great fleets of small rafts across large expanses of water in the British colony.

Enclosed in fine copper-mesh baskets in the framework of the box-like rafts are small pellets of cetyl alcohol, product of the sperm-whale's oil. Floating on the surface of the water in the anchored rafts, the tiny white pellets emit the invisible film which retards evaporation.

The initial tests are being based on one pound of pellets to each raft, and one raft to each acre of water. The resultant film, even when broken by wind and waves, automatically repairs itself by the spread of further cetyl alcohol.

Quite Harmless

The Kenya Government Medical Services Department is confirming that the film is harmless to humans. Aquaria of East African Fisheries in Uganda and Kenya's Fish Culture Stations are proving its innocuous effect on larvae, fish, insect and animal life. Birds, incidentally, are gluttons for the pellets. Experts at the East African Anti-Malarial Institute in Tanganyika are studying the possible advantage in mosquito birth-control.

Nairobi City Council is donating the original supplies of cetyl alcohols (2s. 6d per pound—about 35 cents) and paying for the first rafts made at 50s (about $7.00) each by Kenya Government's Public Works Department. The East African Industrial Research Board Laboratories in Nairobi have devised and are operating apparatus to break the blocks, in which the substance arrives, into pellets.

Research Results

All this broad co-operation followed miniature research conducted since January 1955, in four-foot diameter evaporation pans at the Meterorological Station, Nairobi. Those tests revealed an average reduction in evaporation of 50 per cent—and up to 70 per cent on very hot and sunny days.

Encouraged by such results, Mr. F. Grundy, in charge of operations under Mr. D. A. Davies, Director of the East African Meterorological Department, took delivery of his first raft and splashed it into Nairobi Dam. After Preliminary checks on its behavior, it was joined by 105 more rafts on this 88 acre (415,000,000 gallon) partial source of the Kenya capital's water supply.

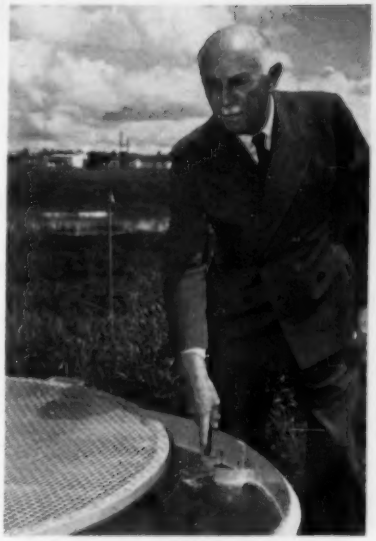
If the success of the miniature experiment is maintained an evaporation saving on Nairobi Dam of some 30,000,000 gallons a year is envisaged—from 50,000,000 lost annually to 20,000,000.

Director Davies computes the "serious and substantial" losses of water through evaporation in Kenya as generally amounting to four to eight feet each year according to the particular locality. In some cases it is as high as 10 feet.

The Prospects

Noting the results gained from the evaporation-pan tests Mr. Davies declared: "There seems no reason why a substantial reduction in evaporation should not be achieved from large water surfaces once suitable techniques have been developed." But he stresses that they agreed procedure "is experimental and may need adjustment in the light of further experience." At the moment he believes that one treatment with cetyl alcohol will last for several years.

Great areas in Kenya have less than 20 ins. rainfall a year; in other parts the rains are frequently erratic. Population must often endure restrictions; cattle may be trekked miles to farmland dams which, though being rapidly increased in numbers under present widespread schemes, are sometimes dwindling to inadequacy. The success of East Africa's vast anti-evaporation adventure could well change the whole uneasy picture overnight.



Hydrologer, F. Grundy, in charge of the experimental work, points to the crystals.

Ed. Note: Not only do these experiments augur well for Kenya but if cetyl alcohol treatment is as effective for evaporation control as it appears to be, many cities in our Southwest may find the method useful.)

LOADING a boat with anti-evaporation rafts containing cetyl alcohol.

WATER WORKS PRACTICES

Tastes and Odor Control—Part 2

The thirty-second of a series

by GEORGE E. SYMONS, Ph.D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

E . . . Preventive Treatment

1 . . General

a. Surface water supplies, particularly impounded reservoirs and lakes, are subject to tastes and odors from organic matter, algae, weeds, etc.

b. Most preventive measures are concerned with algae and weed control.

c. Swampy areas, which are conducive to weeds, rushes, and algae growth should be filled in where possible.

d. Since deciduous trees give rise to decaying leaves, the planting of coniferous trees around reservoirs is desirable.

e. Natural odors in ground waters cannot be prevented.

2 . . Algae Enumeration

a. Tastes and odors associated with algae usually occur when concentration of the organisms reach a minimum limit.

(1) Weekly miscroscopic tests should be made.

(2) Different algae grow best at different temperatures. Critical temperatures have been found to be 41, 50, 59, 68, and 77 degrees F.

b. Determination of the kind and number of organisms is accomplished through miscroscopic examination.

(1) Technique of the examination involves concentration of 250 ml. of water in a Sedgwick-Rafter filter, followed by microscopic observation of one ml. of the concentrated sample using a 10 X ocular and a 7.5 mm objective.

(2) The "Areal Standard Unit" is the best method for counting organisms. This is accomplished by placing an ocular micrometer in the microscope tube at the focal point of the lens.

. . . The area of the micrometer is divided into 100 squares, one of which is subdivided into 25 smaller squares.

. . . The smaller square has an area of 400 square microns (20 x 20 microns) and is termed one standard unit; the larger square is equal to 25 standard units.

(3) The number of standard units per ml is determined and reported.

. . . At least ten squares are counted and tabulations made on a record sheet similar to that used by S. O. Swartz, Bacteriologist, Water Division, Metr. Dist. Comm., Boston, Mass. (See Fig. 1).

c. It is generally stated that from 500 to 1000 areal standard units of odor-producing organisms will cause trouble, but the range varies widely for different organisms.

(1) Many operators consider Synura to be objectionable whenever its presence can be detected.

(2) The Metropolitan Water Commission of Boston sets the following maximum allowable limits of troublesome algae, at which limit treatment is instituted:

Organism	Std. Units /ml
Asterionella* (Fig. 2)	3000
Tabellaria	2500
Synedra	3000
Aphanizomenon	1000
Anabaena	600
Cryptomonas	200
Chlamydomonas	10
Dinobryon	500
Synura (Fig. 2)	200
Ureglenopsis	200

d. Water works which have algal taste and odor problems should have the following references in their libraries:

(1) "Microscopy of Drinking Water" 4th Ed. by Whipple, Fair and Whipple, (John Wiley & Sons)

(2) "Use of Copper Sulfate in Control of Microscopic Organisms" (1954 Ed.) by Frank E. Hale, Ph.D., (Phelps Dodge Refining Corp.).

(3) "Taste and Odor in Water Purification" (Ind. Chem. Sales Div., W. Va. Pulp and Paper Co.)

(4) "Algae of Importance in Water Supplies" by C. M. Palmer and C. M. Tarzwell, with illustrations in color by H. J. Walter. (Reprinted from Public Works Magazine p. 107-120, June 1955.)

(5) "Algae Control and Methods of Enumeration" by Samuel O. Swartz (Taste and Odor Control Journal Nov. 1953 and Jan. 1954)

3 . . Algae Control by Cu SO_4

a. The most common and most widely used method of algae destruction and control is by copper sulfate, a treatment first used by Moore and Kellerman in 1904.

b. There are several methods of applying the copper sulfate to a reservoir or lake.

(1) Drag burlap bags, containing about 50 pounds each, through the water by means of boats, this is the simplest method.

. . . A zigzag course is followed (See Fig. 3) so as to triangulate the surface.

. . . Wind, waves and gravity mix the treated surface layer with the rest of the water.

(2) Scatter small dry crystals over the surface; accomplished by a blower device which handles the dry crystals.

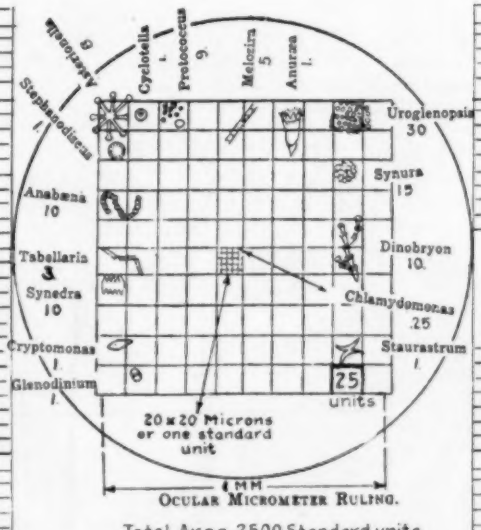
. . . Distribution is made from a power boat and covers a wide area

NO. OF SQUARE	Approx. Values	1	2	3	4	5	6	7	8	9	10	Total	No. per c. c.	Standard units per c. c.
DIATOMACEÆ														
Asterionella	.5	18	16	12	6	20	10	4			6	94	188	94
Cocconeis	5.									1		2	4	2
Cyclotella	5			1										
Cymbella	5.													
Diatoma	3													
Eunotia														
Fragilaria	2.5													
Gomphonema						10						10	20	20
Melosira														
Meridion											1	1	2	6
Navicula	5.											1	2	3
Nitzschia	1.5		1											
Pleurosigma									1		1	5	10	10
Stephanodiscus		1		1		1								
Surirella														
Synedra	3/7	5		10		25	6		30		15	91	182	78
Tabellaria	7/3	4		5		15		10		20		54	108	95
CHLOROPHYCEÆ														
Ankistrodesmus														
Botryococcus														
Closterium				3						2		5	10	10
Conferva														
Cosmarium		6							10			16	32	32
Protococcus														
Scenedesmus														
Sphærozosma														
Spirogyra														
Staurastrum														
Ulothrix														
Volvox														
Zoospores														
CYANOPHYCEÆ														
Anabæna														
Aphanizomenon														
Chroococcus														
Clathrocystis														
Coelosphærium														
Gloeocapsa														
Lyngbia														
Merismopedia														
Microcystis														
Oscillaria														
SCHIZOMYCETES AND FUNGI														
Crenothrix														
PROTOZOA														
Actinophrys	4.													
Anthophysa														
Arcella	10.													
Bursaria														
Ceratium	15.													
Chlamydomonas	.25													
Ciliata														
Codonella	8													
Colpidium	15.													
Cryptomonas														
Difflugia	10.													
Dinobryon	5													
Encelys	1.													
Epistylis	7.													
Euglena	2.5													
Glenodinium	2.													
Halteria	8.													
Mallomonas														
Monas	.1													
Nassula	15.													
Peridinium	5.													
Synura														
Tintinnus	10.													
Trachelomonas														
Uroglenopsis														
Vorticella	5.													
ROTIFERA														
Anuræa	15													
Asplanchna	150.													
Brachionus	25.													
Conochilus	15.													
Floscularia	15.													
TOTAL ORGANISMS														350
AMORPHOUS MATTER		10	8	8	5	10	5	8	10	5	10	79		158

All organisms are enumerated by the areal measurement. Filaments and spheres are counted as one unit. The Whipple micrometer shown on this sheet has been enlarged to demonstrate the method used in counting algae. The approximate values shown on this chart were estimated by G. C. Whipple.

N= number of squares counted
T= total number of organisms found in all squares counted
V= number of cubic centimeters of samples filtered
C= number of cubic centimeters of water used in washing the samples
S= number of millimeters of slide

$$N = \frac{T}{10} \times \frac{\frac{S}{1000} \times \frac{C}{5\text{c.c.}}}{\frac{250}{V}\ \text{c.c.}} = 2T$$



MICROSCOPIC EXAMINATION OF WATER

By Samuel O. Swartz
Water Division
Metropolitan District Commission
Boston, Mass.

Courtesy Taste & Odor Control Jour.

Fig. 1—RECORD sheet for microscopic examination of water—After Swartz

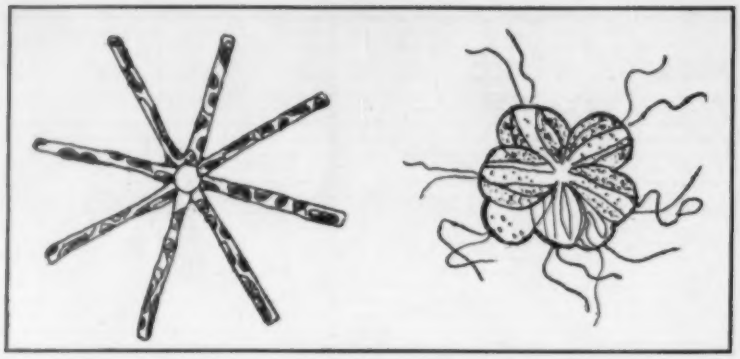


Fig. 2—EXAMPLES of algae—Synura, left; Asterionella, right.

(up to 50 ft. wide) and the boat traverses the surface area by zigzag movement to give complete coverage.

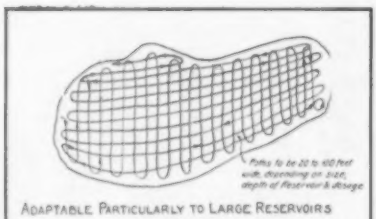
. . . Where the waters are hard and copper salts precipitate rapidly, this means is effective since the size of crystal can be chosen to insure its rate of sinking and rate of solution in the water.

(3) Feed dry crystals directly into propeller wake of a power boat.

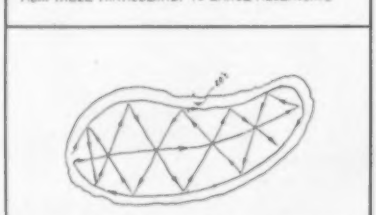
(4) Spray crystals in a stream of water or spray a solution; accomplished through a pump and injector arrangement.

(5) Dissolve copper sulfate by water forced through solution boxes when the boat is in motion, with the solution distributed behind the boat through perforated pipes; this method works well but covers a relatively small area for each traverse of the boat.

(6) Dry feed or solution chemical feeders can be used where the inflow to a reservoir passes through a conduit or control section, one simple type of continuous solution feeder is shown in Fig. 4.



ADAPTABLE PARTICULARLY TO LARGE RESERVOIRS



ADAPTABLE PARTICULARLY TO SMALL RESERVOIRS

Courtesy—Ind. Chem. Sales Div.

Fig. 3—DIAGRAM of boat path for copper sulphate treatment of reservoirs

c. Dosage of copper sulfate is made in pounds per million gallons of water in the reservoir and varies according to the type of algae being treated.

(1) Copper sulfate is quite soluable as indicated in the following tabulation:

Temperatures °C	°F	lb $CuSO_4 \cdot 5\ H_2O$ per 1000 gal
0	32	186
10	50	227
20	68	269
30	77	326
40	86	371

(2) Dosages are calculated from ppm values given in detail in the article by Hale. A summary of ranges is shown in Table 2.

TABLE 2

Concentration Ranges for Copper Sulfate and Chlorine Required to Kill Algae (After Hale)

Organisms	$CuSO_4$ ppm	Cl_2 ppm
Diatoms	0.1 to 0.5	0.5 to 2.0
Green	2.0 to 10	0.3 to 1.5
Blue-Green	0.1 to 0.5	0.5 to 1.1
Iron Bacteria	0.3 to 0.5	0.5
Sulfur Bacteria	5.0	0.5
Protozoa	0.1 to 2.0	0.3 to 1.0

(3) Copper sulfate dosage should not be made in the immediate vicinity of intakes to the water plant.

d. Copper sulfate is toxic to fish. Moore and Kellerman set the following safe limits for different fish:

Fish	$CuSO_4$ limit ppm	lb/mil gal
Black Bass	2.0	16.6
Carp	0.33	2.8
Catfish	0.4	3.5
Gold fish	0.5	4.2
Perch	0.67	5.5
Pickerel	0.4	3.5
Sunfish	1.35	11.1
Suckers	0.33	2.8
Trout	0.14	1.2

4 . . ALGAE CONTROL BY CHLORINE

a. Chlorination for the control of algae is most generally used only when the chlorine can be added to the inflow to the reservoir, but the addition of liquid chlorine at approximately 25 feet depth has been used in the Los Angeles supply.

b. New York City reports that 2 ppm of chlorine will control Synura infestation in the Croton supply.

c. In some locations, combinations of copper sulfate and chlorine are used, with better algicidal results than either alone—a combination of copper sulfate, chlorine and ammonia will form cupric chloramine which will tend to prevent the precipitation of copper.

5 . . ALGAE CONTROL BY BLACKOUT

a. Sunlight is essential for algae growths; exclusion of sunlight from small reservoirs reduces the tendency for algae to proliferate.

b. Addition of powdered activated carbon to the surface of a reservoir literally "blacks out" the sunlight, first because the many particles of small size actually prevent passage of light into the water and secondly because the carbon particles are black and absorb light.

c. Slurries of activated carbon are distributed over the surface of the reservoir, either from a burlap bag towed behind a boat, or from a jet or ejector system or pump.

d. The amount of powdered activated carbon used varies from 0.2 to 0.5 lb per 1000 sq ft of surface area.

(1) The amount is well below that required for taste and odor removal but does aid in such removal to the extent that it reduces the amount of carbon required in later treatment, if needed.

(2) Blackout treatment need be practiced only on sunny days.

e. This type of treatment was developed by the St. Louis County Water Co. in 1938 and was named the "carbon blackout" treatment by W. P. Bailey at Council Bluffs, Iowa in 1940.

6 . . WEED CONTROL

a. Weeds which cause taste and odor problems do so principally on death and decay and it is the weeds which grow in the water, not those which grow on the reservoir banks, which cause the most trouble.

(1) Emergent weeds are those which are rooted in the bottom but have tops above the water (cattails, water hyacinth and water lillies).

. . . The limiting depth of attached weeds is about 40 feet.

(2) Submerged weeds grow whol-

ly or almost wholly under water (water milfoil—Fig. 5)

(3) Floating weeds which resemble the lily family.

(4) Discharge of waste-waters, rich in nitrogen and phosphorous, in water supplies will fertilize the growth of weeds.

(5) Heavy weed growth year after year will gradually fill shallow areas causing loss of reservoir capacity.

b. There are four ways for controlling weed growth:

(1) Draining shallow areas during hot weather, allowing the exposed plants to die and thus destroy the roots and runners which are the principal method of propagation.

(2) Dredging weeded areas will remove the entire plant.

(3) Underwater cutting is successful for flowering weeds but provides only temporary relief for weeds which propogate by runners, tubers, buds or stem fragments.

. . . Dragging the bottom with chains or bars is similar in effect to underwater cutting.

(4) Chemical treatment offers an effective solution in many cases but is not without its own problems.

. . . Chemicals used include:

2, 4-Dichlorophenoxyacetic acid (2, 4-D)
Ortho-dichlorbenzene
Sodium arsenite
Copper sulfate
Sodium chlorate
Ammonium sulfamate
Borascu (unrefined borax ore)

. . . For common emergent plants, 2, 4-D apears best in concentrations of 1 pint diluted to 6 gallons for about 10,000 sq. ft. of weed area. More than one application of chemicals may be necessary.

. . . Arsenicals cannot be used on water supplies for man or animals.

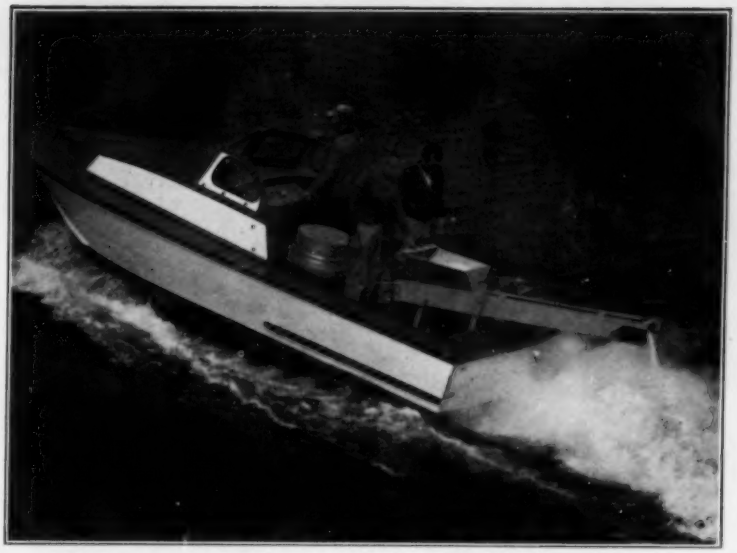
. . . Some chemicals are toxic to fish and their use must be in such a manner as not to destroy fish life.

. . . Some chemicals containing the benzene ring as a basic component may break down to phenols which will cause chlorophenol odors in supplies utilizing chlorination.

7 . . Pollution Control

a. Prevention of pollution from sewage or industrial wastes is the best control measure where such pollution is likely to be a source of odor cause.

b. Elimination of such pollution also reduces the content of fertilizer nutrients which stimulate algae and weed growth.



COPPER sulphate treatment of reservoir with belt conveyor chemical feeder at Los Angeles

F . . . Corrective Treatment

1 . . Aeration

a. Historically, aeration came first as a direct treatment for taste and odor removal in modern practice (1860) although bone char filters had been used in England in 1807.

b. When used for odor removal, aeration provides a stripping action for the removal of volatile compounds.

c. Aeration theory, types of aerators, application of aeration and problems have all been presented in a previous lecture on Aeration.

d. The relatively low efficiency of aeration for removing odors in water supplies causes some doubt as to its efficacy as a treatment for that purpose.

(1) Removal of odors by aeration depends on the volatility of the odorant.

(2) Removal is dependent on temperature.

(3) In some cases introduction of oxygen increases corrosivity of the water, and sometimes odors are apparently enhanced by aeration.

(4) Aeration frequently involves power for pumping and may be an expensive treatment for a somewhat dubious effect.

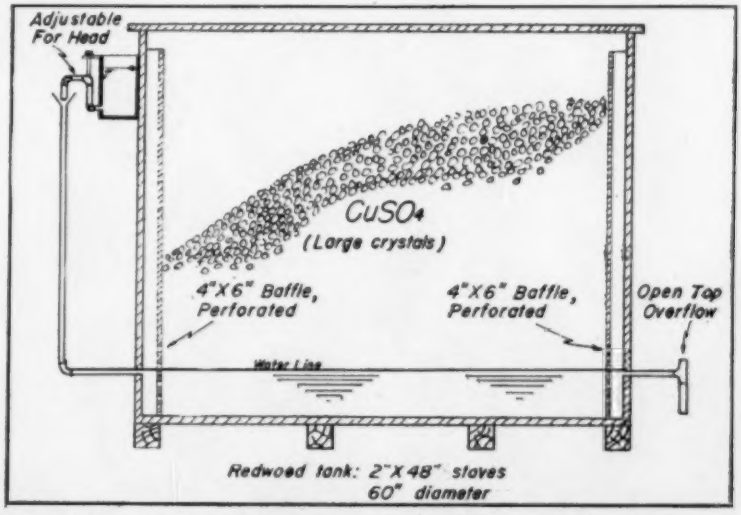


Fig. 4—CONTINUOUS copper sulphate solution feed tank—After Derby and Townsend

Fig. 5—EXAMPLE of weed—water milfoil —After Steel

2 . . Coagulation and Sedimentation

a. Tastes and odors associated with solid or colloidal matter in water can be removed by coagulation followed by sedimentation and filtration.

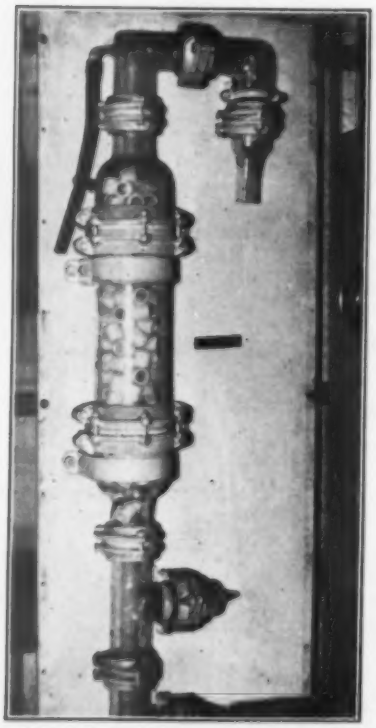
b. If the odor causing substance has disassociated itself from solid matter to the extent that it is dissolved then these treatment processes are of little aid to odor removal.

c. Undesirable tastes and odors may result from sedimentation tanks and filters.

(1) Theoretically, 1 part of chlorine tling tanks may release odors into the water.

(2) Algae type growth in filters and mud balls likewise may impart odors to a water.

(3) Clean filters and settling basins in which sludge is regularly removed are the best preventives for odor from either of these sources.



CHLORINE dioxide generator for mixing sodium chlorite and chlorine solutions

3 . . Chemical Oxidation

a. Since most odoriferous compounds exist in a reduced state chemically it is to be expected that these odors can be destroyed by chemically oxidizing the odorant.

b. These compounds are and have been used successfully for this purpose: chlorine, chlorine dioxide and ozone.

c. Chlorination for the purpose of destroying odors is the most common of these chemical oxidation processes.

(1) It is most effective when free available chlorine residuals are produced and maintained.

(2) If ammonia is present and is converted to nitrogen trichloride by the free residual chlorine, then chlorinous odors may result.

(3) If free residual chlorine does not exist, phenols may be converted to chlorophenols which increases the odor problem.

(4) The use of ammonia with chlorine to produce chloramines and thereby minimize chlorophenol odors has generally been discontinued since the advent of free residual chlorination and the understanding of the breakpoint and what it is.

(5) Chlorine for taste and odor control may be applied at a number of points within a plant, coincidental with disinfection.

. . . Ahead of filtration

. . . Following filtration

. . . In the distribution system itself, where it will prevent bacterial regrowth and slimes which may die and decompose with odorous results.

d. Chlorine dioxide (ClO_2) is a strong oxidizing agent produced by the action of chlorine on sodium chlorite ($NaClO_2$), or by the action of acidified hypochlorite on sodium chlorite.

(1) Theoretically, 1 part of chlorine will react with 2.6 parts of sodium chlorite, but in practice the ratio is from 1 to 2 or even 1 to 1 for commercial sodium chlorite (82 per cent $NaClO_2$).

(2) Chlorine dioxide is most effective on phenolic odors, but some operators report algae odors removed by chlorine dioxide with a shorter reaction time required than for chlorine treatment above.

(3) Chlorine dioxide treatment ahead of the filters appears to do the best job.

(4) The chlorine dioxide treatment was first tried in Niagara Falls, N. Y. in 1944-45. Its use has not been widely adopted but among the cities which use it are Lockport, N. Y., Greenwood, S. C., Chicopee, Mass., Morrisville, Pa., Laurence, Kan., and McNeil Island, Wash.

e. Ozone (O_3) is effective as a strong oxidizing agent.

(1) Ozone is produced by the brush discharge of high voltage electric current through dry air

. . . . It requires approximately 0.2 kwh at 15,000 volts to produce one gram of ozone, and only 0.5 to 1 per cent of the oxygen in the air is converted to ozone.

(2) Air cleaners, blowers dehumidifiers, and water cooling devices must accompany the ozone generators, all adding to the cost of power and equipment.

(3) For odor oxidation approximately 1 to 4 ppm of ozone must be added to the water through diffusers in contact basins.

. . . Some observers claim that ozone actually "fixes" some odors rather than removing them.

(4) Ozonation has not been widely adopted in this country but is still undergoing investigation. It has been more widely used in Europe for disinfection rather than odor removal.

4 . . . Adsorption

a. Finely divided particles have large surface areas upon which colloids and dissolved substances, particularly volatile organic substances, will be adsorbed and held. The removal of dye from liquid by cloth and subsequent holding of the dye by the cloth is a good example of adsorption.

b. Certain types of substances, such as finely divided carbon particles can be "activated" to increase the adsorptive capacity of these large surface areas.

c. *Adsorbents* such as activated carbon, when added to water, remove both color and odor causing compounds by this adsorptive action.

d. Adsorption is a rapid process in which the amount of *absorbate* left in solution and the amount removed reaches an equilibrium quickly.

(1) The extent of removal by adsorption of any substance from solu-

tion depends on the characteristics of the substance, its concentration and temperature of the liquid.

. . . Removal is expressed mathematically by the Freundlich equation or the Langmuir isotherm equation, which simply states that the amount of substance adsorbed per unit weight of adsorbent is some function of the concentration of the adsorbate left in solution at the time equilibrium is reached.

. . . Inasmuch as temperature affects adsorption, curves relating adsorbent capacity to concentration of adsorbate remaining are termed adsorption isotherms and are different for different temperatures.

(2) The lower the solubility of the adsorbate in the liquid, the more easily it is adsorbed. Since volatile odorants in water are relatively insoluble, their removal by adsorption is relatively high.

(3) The higher the surface tension of the liquid, the greater its tendency to force foreign substances out of solution, a situation which aids the adsorption mechanism in water treatment.

G . . . Activated Carbon Treatment

1 . . Activated Carbon Production

a. Activated carbon comes in two forms: granular, about 1 mm or less in diameter; and powdered such that 50 per cent will pass a 300 mesh sieve and 95 per cent will pass a 200 mesh sieve.

b. Carbonaceous materials, particularly wood, sawdust, peat, lignite and pulp-mill char are used for the production of activated carbon.

c. Activation is accomplished in two steps:

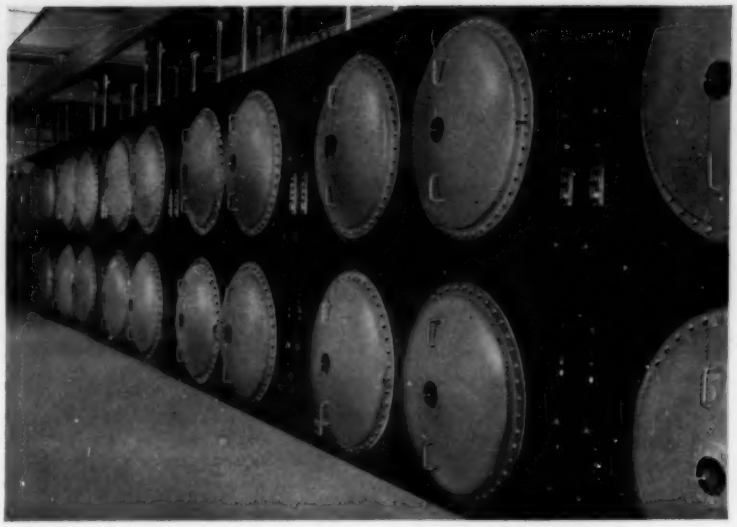
(1) Carbonization of the raw material, in the absence of air at temperatures below 600° C.

(2) Controlled oxidation of the char usually at some other temperature sometimes in the presence of various inorganic chemicals.

. . . Activating agents include air, steam, chlorides (of calcium, iron, magnesium, manganese, zinc) sulfates or phosphates (of calcium, manganese, sodium) boric, nitric, phosphoric or sulfuric acid, etc.

. . . Temperatures used for the activation process may be 800-900°C or 300-600°C if air is used.

. . . Whatever the method and the temperatures used the activation process is carefully controlled to produce the adsorptive capacity desired for the removal of particular types of substances, and at the same time produce the maximum possible amount of activated carbon from the amount of raw material used.



BANK of ozonators in Philadelphia.

2 . . . Adsorptive Capacity

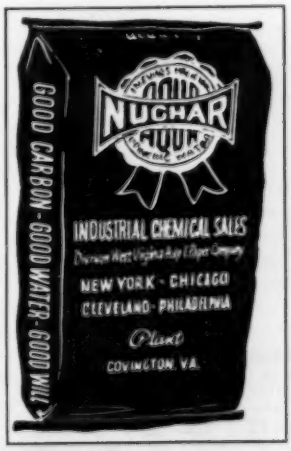
a. By virtue of the activation followed by grinding, not only is the surface adsorptive capacity increased, but the surface is eroded giving an even larger surface area per unit diameter of particle.

b. One cu ft of powdered activated carbon is estimated to have a surface area of about 3 million sq ft, and one gram contains about 120,000,000,000 individual particles.

c. Surface area alone is not a criterion of the ability of activated carbon to adsorb odor compounds; a standard test for adsorptive capacity uses pure phenol as the substance to be removed, and that capacity is termed the "phenol value".

(1) Phenol value is the amount of activated carbon, expressed as mg per liter, required to reduce the concentration of phenol from 100 ppb (0.1 ppm) to 10 ppb (0.01 ppm).

(2) Activated carbons which have a "phenol value" greater than 30 are not generally acceptable for taste and odor removal in water plants.



ACTIVATED powder bag in position for opening

3 . . . Points of Application

a. Two general rules are recommended for the use of activated carbon for taste and odor removal.

(1) Apply carbon where thorough mixing and adequate dispersion are effected.

(2) Be sure the carbon remains in contact with the water (and the taste and odor compounds, therein) for 15 to 20 minutes to obtain maximum removals.

b. Each individual plant should determine the point of application which produces the best results with the least possible carbon dosage.

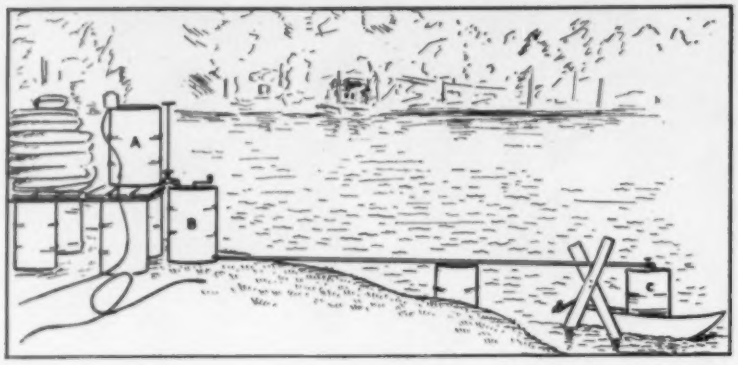
(1) Threshold odor determinations will aid in this determination.

(2) Different odors may require different points of application as well as different amounts of carbon; therefore, threshold odor studies with reference to points of application should be made whenever there is an odor change in the raw water.

c. The various possible points of application are:

(1) Raw water
(2) Rapid mix basin
(3) Flocculators
(4) Mid-settling basin
(5) Conduit to filters
(6) Top of filters (after each washing)

d. Split treatment may be found effective and where carbon is added to or reaches filters, the filter wash water



Courtesy H. E. Bailey & J. Studley

Fig. 6—SKETCH of arrangement for carbon treatment plant at open reservoir

containing carbon may be returned to the raw water ahead of coagulation.

e. Emergency application to combat sudden and severe taste and odor problems usually calls for large amounts of activated carbon to be added to the mixing basin and to the tops of the filters until the severe condition has passed.

f. Addition of carbon to reservoirs for blackout purposes has been mentioned previously. (Fig. 6)

4 . . . Dosage Determination

a. The amount of activated carbon required depends on intensity of odor, type of odor, quality of water acceptable by the customers and the adsorptive capacity of the activated carbon.

b. No single threshold odor number in the treated water can be set as applicable to all water supplies. A threshold odor number of 2 will usually cause no complaints, but many supplies are acceptable at higher values.

c. Technique of determination (Adapted from "Taste and Odor Control in Water Purification", Chapt. IX).

(1) All equipment used must be clean and odor free.

(2) Obtain several gallons of water ahead of chosen point of application.

(3) Make up stock carbon suspension (1g per L of odor-free water) from the carbon supply to be used for treatment.

(4) Determine the maximum threshold odor number allowable in the finished water.

(5) Set up five 1-liter portions in jars and dose four with incremental amounts of the stock carbon suspension (the fifth jar is the blank)

(6) Agitate each jar 30 minutes, coagulate, filter and determine by sniffing which sample has the lowest carbon dosage giving an acceptable water.

. . . Several operators should perform the sniff test

. . . More precise determination can be made by determining the threshold odor numbers on each of the five samples.

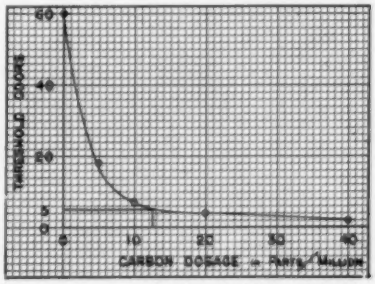
(7) Plot the results (carbon dosage vs threshold odor number) on arithmetic graph paper and by interpolation determine the proper dosage to give the desired threshold odor number.

. . . . An example of such a plot is shown in Fig. 7).

5 . . Handling and Feeding

a. Powdered activated carbon is shipped in bulk (covered hopper cars) four-ply multiwall paper bags (35 lb) cloth bags, barrels or boxes.

(1) Most water works use the paper bags, particularly where less-than-carload lots are ordered.



Courtesy—Ind. Chem. Sales Div.

Fig. 7—DOSAGE determination plot

(2) Bulk shipments were inaugurated in 1949 for Chicago and have been used in several other large cities since that time.

b. Storage space for bagged carbon should be dry and free from air contaminants such as chlorine, gasoline, sulfur dioxide fumes, smoke etc.

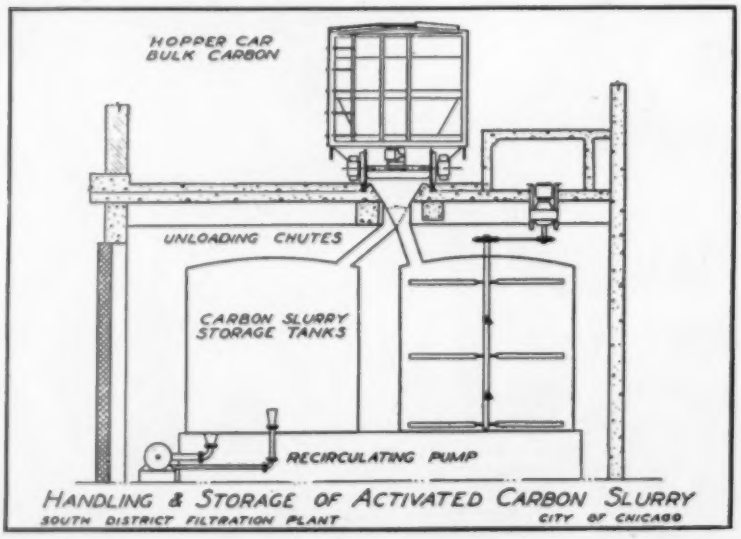
(1) Bags of activated carbon should be stacked on pallets, about 3 in. off the floor to allow circulation of air around the bags and prevent soaking the bottom bags if the floor becomes wet.

(2) Bags should be interlocked to prevent slipping.

c. Activated carbon will not explode and it is not subject to spontaneous combustion, but it will burn if ignited. For this reason certain precautions are recommended.

(1) No flames (no smoking), no sparks, heating devices or electric equipment subject to arcing should be in the storage room.

(2) An overall sprinkler system is desirable in the storage and feeding rooms.



Courtesy J. R. Baylis

Fig. 8—HANDLING and storage of activated carbon slurry at Chicago

(3) If the carbon does catch fire, it will not blaze, and the safest procedure is to allow it to smolder until it burns out.

. . . Never squirt or throw water on burning carbon; such action will only cause the ignited particles to fly, and thus spread the fire.

d. Powdered activated carbon may be fed by dry chemical feeders or as a slurry.

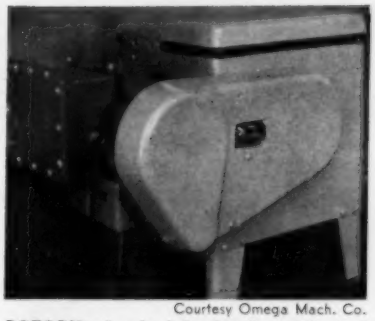
(1) Modern dry chemical feeders provide for dust prevention, accurate feeding, and adequate wetting down of the carbon.

(2) Slurry feeding is highly satisfactory with various types of pumps, weir boxes or Rotodip feeders.

. . . Slurries may be made directly from bulk shipments of carbon unloaded into concrete storage tanks provided with ample agitation. (Fig. 8).

. . . Making and storing of the slurry in this manner requires less man hours than handling packages to dry feeder.

(3) Handling and feeding of activated carbon was also discussed in the latter part of the lecture on Chemical Handling and Feeding.



Courtesy Omega Mach. Co.

ROTODIP chemical feeder for activated carbon slurry

(4) More detailed discussions of handling and feeding powdered activated carbon appear in Chapters X and XI of "Taste and Odor Control in Water Purification" published by the Ind. Chem. Labs Div., W. Va. Pulp and Paper Co.

6 . . Granular Carbon Filters

a. Granular activated carbon filters are used principally in the bottling industry.

b. Municipal installations of granular activated carbon filters are relatively few. Some are in pressure filter installations, and some in regular sand filter plants.

(1) Activated carbon filters cannot replace sand filter, and can be used only where the water is free of turbidity.

(2) Their use is justified for removing final traces of odor or as protection against surges of odor which might get by the regular treatment.

H . . . References

Material for this lecture was obtained from the following reference texts, as well as articles in the technical journals and magazines.

AWWA—"Manual of Water Quality and Treatment" 2nd Ed., Chap. 10. (Amer. Wat. Wks. Assn.)

Fair and Geyer—"Water Supply and Waste-Water Disposal"; Chap. 18 and 27. (John Wiley & Sons)

Hale, F. E.—The Use of Copper Sulfate in Control of Microscopic Organisms, 1954 Ed. (Phelps Dodge Refining Corp.)

"Taste and Odor Control in Water Purification", 1955 Ed. (Ind. Chem. Lab. Div., W. Va. Pulp & Paper Co.)

A Water-Borne Infectious Hepatitis Outbreak

The inability of contemporary water treatment plants to effectively cope with certain of the pathogenic virus has been brought sharply into focus by a recent water-borne infectious hepatitus epidemic in Delhi, India.

During December, 1955, and January, 1956, between 20,000 and 40,000 cases of infectious hepatitis occurred among residents of Delhi. An investigating committee set up by the Chief Commissioner of Delhi found that the infectious virus of hepatitus were transmitted through the Delhi water system.

The Delhi water supply is taken from the Jamuna River and treatment in a plant of modern design, consists of alum coagulation, sedimentation, filtration and chlorination. The water plant intake is upstream from Delhi's sewer outfalls; but a shifted river channel, wrought by flood, caused sewage from the nearest outfall to flow to the water intake. Though a gross contamination of the raw water supply resulted, the treatment provided was adequate to produce a treated water free of coliform organisms. No untoward increase in incidence of enteric disease among the population of Delhi was noted. Thus, by standard quality criteria, the water was safe to drink.

Chemical analysis disclosed a rise in the chloride content of the water from a normal of about 5.6 ppm. to a high of 90 ppm. at the peak of the contamination period. The sewage at the outfall contained a chloride content of 160 ppm., which would indicate that the water entering the purification plant contained as much as 50 per cent sewage. Yet, because of the negative coliform tests, and certain administrative difficulties, corrective action was not taken by the authorities in time to prevent the serious epidemic which ensued.

The chlorine residual varied from about 0.2 ppm. at the onset of this incident to 0.7 ppm. at the time remedial measures were being taken.

This experience would seem to indicate that present techniques for determining the bacteriological quality of drinking water are not adequate to assure a safe water supply in areas where raw water sources contain pathogenic virus which are not susceptible to present treatment methods. Further research to determine free and combined available chlorine dosages necessary to destroy or inactivate pathogenic virus under various conditions of contact time, pH, temperature, and other environmental conditions seems warranted. —*D.H. Howells*

Chamberlin Joins Haven and Emerson, Consultants

Noel S. Chamberlin joined the staff of Havens and Emerson, Consulting Engineers of Cleveland and New York City, on July 1st.

A Chemical Engineering graduate of University of Pennsylvania, Mr. Chamberlin did graduate work and served as an instructor for several years in the Sanitary Engineering Department of Rutgers University. Throughout the balance of his career, comprising some 25 years, he has been engaged in the water and wastes engineering field, particularly with reference to the chemistry and bacteriology of water and the problems of sewage and industrial waste treatment.

Mr. Chamberlin was for some years associated with the Federal Water Service Corporation, and more recently with Wallace & Tiernan, Inc., in the Division of Technical Services. He is the author of many articles and technical papers.

Although Mr. Chamberlin's headquarters will be in New York, his services will be made available to clients through both offices of Havens and Emerson.

Metering and Rate Structures

A review of practices in the United States

by E. SHERMAN CHASE

Mr. Chase is a partner in Metcalf and Eddy, Consulting Engineers, Boston, Mass. This article has been adapted from a report presented by Mr. Chase at the International Water Supply Congress and Exhibition in London.

METHODS of charging for water service in the United States vary widely, although the majority of water works systems use meters to measure the quantity of water delivered to their customers. The manner of dealing with rate structures is also highly diverse, due to the non-uniformity of laws and regulations in the different municipalities and states.

Among the first (if not the very first) of the discussions on methods of charging for water in the U.S. was that in 1883 at the second annual meeting of the New England Water Works Asociation. From that time on, the subject has been a constant topic of discussion and of committee reports, with no end in sight.

Although most water works systems in the U.S. measure by meter the quantity of water delivered to customers, there are many systems where meters are used for the larger consumers only. This is true in some of the larger cities like New York and Chicago. Where meters are not employed and where the amount of water used is unknown, it becomes necessary to devise other methods of charging for water.

Rate Structures

Rates based upon the number and types of plumbing fixtures are less common today than fifty years ago. Rates established in this way may not be too inequitable in small communities, but have little virtue in the larger cities and towns. Such rates too often result in careless use of water and neglect of leaking plumbing fixtures. Usually, a minimum charge is set up; and where it appears that large quanities of water are used on the premises, meters are installed and rates established for the water consumed.

In view of the nearly universal acceptance of metering as a means of securing payment for water service, substantially the whole of the water works literature in United States dealing with charges has been devoted to methods for determining logical meter rates.

Diversity in Principle

Despite the consideration given to this subject over the years, there is not yet any general agreement upon many of the details involved in determining charges for water. The latest thinking in the United States is exemplified in two reports appearing in 1951[1] and 1954[2], respectively.

The first of these reports (prepared by the Joint Group of Committees from the Amer. Soc. of Civ. Engr. and the Sect. of Muni. Law of the Amer. Bar Assn, together with representatives of six other such associations including AWWA) stated that the fundamental principle governing the determination of fair rates and rate structures for waterworks is as follows:

"The needed total annual revenue of a water . . . works shall be contributed by users and non-users (or by users and properties) for whose use, need, and benefit the facilities of the works are provided approximately in proportion to the cost of providing the use and the benefits of the works."

The Joint Report further states:

"The application of this principle to the determination of fair rates and rate structures for any particular situation will involve, in the first instance, the determination of the share to be borne by users and non-users, and in the second instance, an allocation between different classes of users and non-users."

The second report, issued by the Water Rates Committee (A4.B) of the Amer. Water Works Assn., examined four bases for determining rates for water charges. These are:

"1. A demand basis for normal users, including a service charge for each size of meter and commodity rates in three steps. The service charges are to include: all commercial expense, all costs chargeable to meters and services, and a demand charge equal to 50 per cent of the fixed costs. All special uses are to be charged separately to customers.

"2. A functional cost basis for normal users, differing from the demand basis only in that all fixed charges are included in the commodity rates; minimum bills are based on the sum of the service charge plus the use of 9,000 gallons per quarter for each equivalent ⅝ in. meter.

"3. Commodity rates only, without a service charge, but substituting a suitable minimum charge, and with all special uses charged separately to customers.

"4. Commodity rates only, without a service charge, but with a minimum charge sufficient to provide all the costs of special uses."

Divergence in Practice

While the principles advocated by these Committees may be considered theoretically desirable, the fact remains that in most of the municipally-owned systems in the U.S. the charges for water are not based upon such principles. This is due to a variety of causes. There has been no unanimity of opinion among water works engineers and officials, themselves. Political pressures to keep charges low, to discourage metering, and to postpone needed improvements have lamentably influenced the rates actually established. Further, there is no complete agreement as to whether the rates set up for publicly-owned works should be based on the same principles as those for privately-owned works. Disagreement exists as to whether the muncipality should pay for fire protection. Although there is general accord with the premise that the water utility should not furnish "free water" to public and semi-public buildings, it is the practice for many waterworks to do so.

Even where meters are in use, there is considerable variation in actual practice in the determination of minimum charges and in the use of step or block rates for varying amounts of water consumption.

Revenue Requirements

The revenue required by a water works system is essentially the sum of the following factors:

(a) Operating expenses.
(b) Debt service.
(c) Depreciation (to extent not covered by debt service).
(d) Allowance for routine replacement and expansion.
(e) Taxes.
(f) Return on rate base (privately owned).

In regard to item (f), there is some disagreement. Several authorities con-

TESTING water meters is first step in periodic maintenance program

tend that privately-owned and publicly-owned utilities should be treated alike; other authorities take the opposite view.

One method for meeting these revenue requirements calls for dividing the cost of the water service into three classifications. These are capacity cost, commodity cost, and customer or consumer cost. In addition, this method classifies the users of the water service into four groups: residential, commercial, industrial, and those outside the city.

The capacity cost sometimes called the demand or ready-to-serve cost, is allocated to each group of users on the basis of the maximum peak load represented by that group. This capacity cost is then divided among the members of the group according to the demand of each member. The commodity cost, or production cost, is the cost of producing, purifying, and distributing water. It is determined by dividing the production cost by the total units consumed. Customer cost includes the expenses of meter reading, billing, collecting, and accounting. It is the same for each customer and is determined by dividing the total of such costs by the number of customers.

Step Rates or Sliding Scales

Another phase of the water-rate problem relates to the justice of charging lower rates for large than for small amounts of consumption. Although there is no complete unanimity of practice in the U. S., statistical data collected in 1950 by the AWWA indicate that, in cities of 10,000 population and over, the step rate or sliding scale of charges is generally adopted. The average rate for minimum use has been approximately twice that for maximum use. Generally speaking, most waterworks systems set up minimum charges under which a given amount of water may be used before additional charges are made. Relatively few make a service charge, and the adoption of rental charges for meters does not appear to be the practice at present, although fifty years ago it was not uncommon.

Governmental Regulation of Charges

Practically all the states have laws setting up public service commissions for the regulation of privately-owned public utilities. Such agencies have the power to regulate the rates charged by publicly-owned water utilities in only six states. Wisconsin is one of these and its Public Service Commission acts on the theory that privately-owned and publicly-owned waterworks should be operated on proper economic principles. Consequently, the Commission has ruled that: 1. Publicly-owned waterworks are entitled to the same rate of return as privately-owned systems. 2. "Free" service is unlawful. 3. All services, except fire protection, must be metered. 4. Public fire protection must be paid for by the municipality on the basis of allocated costs. 5. Rate schedules must be equitable. 6. The utility should establish reasonable rules and regulations relative to financing extensions and service connections.

There is some difference in practice as to the approval by public utility commissions of rates charged by private water companies. Some states have adopted the theory of a fair return upon fair value (prudent investment doctrine), while other states proceed on the basis of fair return on original cost less straight-line depreciation.

Summary

In brief, the practices in the United States regarding water metering and water rate structures may be summarized as follows:

1. Metering is almost the universal practice of charging for water service but 100 per cent metering does not exist in most communities.
2. There are diverse principles existing regarding rate structures and divergence in the practice of applying these principles.
3. Methods of meeting revenue requirements and the use of step rates or sliding scales also vary.
4. Practically all states provide regulation of private utilities by public service commissions but only six states also regulate publicly owned utilities.

References

1. "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works", Joint Report of American Society of Civil Engineers and the Section of Municipal Law of the American Bar Association.
2. "Determination of Water Rate Schedules", Joint Report of American Water Works Association and New England Water Works Association.

Ed. Note: Although the law of six states permits regulation of publicly owned water utilities, only Wisconsin and Maine have applied any appreciable regulation of municipal water utilities by the State Public Service Commissions. Such regulation in Wisconsin has proved of noteworthy benefit.

Equivalent Pipe Size Nomograph

For pipes in series or in parallel

by PAUL M. ALBERT

Mr. Albert is a consulting engineer in Ann Arbor, Mich. This article and its accompanyng nomograph is another useful tool of this type for which he is well known.

MANY excellent nomographs have been published for determining the friction head and velocity in water pipe lines. Most charts give diameter, slope of the hydraulic grade or friction head, velocity and rate of flow. For a single pipe size and a given length of pipe, the calculations are simple but where more than one size is involved (series or parallel pipes) the work involved may be quite complex and often tedious.

To simplify such calculations the "Equivalent Pipe" method is often used. With this method one enlarges or reduces some or all the pipes and combines them into a single pipe which has "equivalent" hydraulic characteristics. From this point on the equivalent pipe may be used instead of the actual pipes for calculation of the head loss and flow rate of the network, thus greatly reducing the work in solution of the problem.

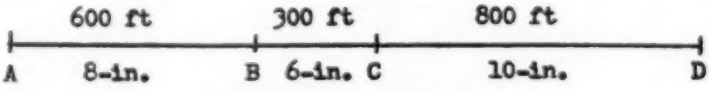
The accompanying chart contains two nomographs, one to use for Series Pipes and one to use for Parallel Pipes. The Series Pipe nomograph uses three vertical lines, (H) for head loss, (d) for diameter of pipe, and Length. The Parallel Pipe nomograph also uses three vertical lines (Q) for gpm or cfs, (d) for diameter of pipe, and Length. Both use the same vertical line for Length. For a given problem, when using the chart for either series or parallel pipes use ONLY pipe diameters to the left, or to the right of the vertical line for (d), do not interchange in any one problem. Two ranges of (Q) are shown, 250 gpm and 500 gpm, for the Series Pipe (d) and two ranges are shown for (H) of 10 ft and 50 ft for the Parallel Pipe (d). This allows the user to choose values of (d), one side or the other, which better fits the problem and enlarges the useful range of the chart.

Single Pipe Equivalents

Many hydraulic problems occur where it would be convenient to change just one pipe to an equivalent pipe which would be of the same size in diameter as the rest of the pipes in that group, either series or parallel or even more complex. This may be done quickly by means of the Series Pipe nomograph of three vertical lines marked Series and Length. Connect the actual length and diameter and find (H). Holding that (H) connect (H) and the desired diameter of the equivalent pipe and find the new equivalent Length. This size and length being the equivalent pipe it may be substituted for the actual pipe for further analysis.

Series Pipe Equivalents

As above, find (H) for each pipe in the series, add each to find the total (H). Connect the total (H), the desired diameter and find the new Length. This is the length and diameter of the "Equivalent Pipe" which, for computation purposes, greatly simplifies further calculations. *Example*-1. Given three pipes in series as shown:



EXAMPLE 1 for pipes in series

Using the Series Pipe nomograph lines

Pipe	*Size*	*Length*	*Q*	*Find H*
A-B	8 in.	600 ft	500 gpm	5 ft
B-C	6 in.	300 ft	500 gpm	10 ft
C-D	10 in.	800 ft	500 gpm	2 ft
A to D			total	17 ft

Assuming that an 8-in. diameter pipe will be suitable for the equivalent pipe, hold 17 ft for (H) and connect to 8-in. for (d) and find the length to be 1900 ft. This is the size and length of the equivalent pipe which may now be used for further calculation in place of the actual pipes. Other diameters could have been selected for the equivalent pipe and the length would also change. If the whole length of the series, 1700 ft actual, had been used to find the equivalent diameter, the diameter would usually fall somewhere between the nominal pipe sizes and therefore would be less easy to use.

Parallel Pipe Equivalents

Similar operations are performed to find an equivalent pipe for parallel pipes and just as simply. *Example*-2, Given two pipes in parallel as shown:

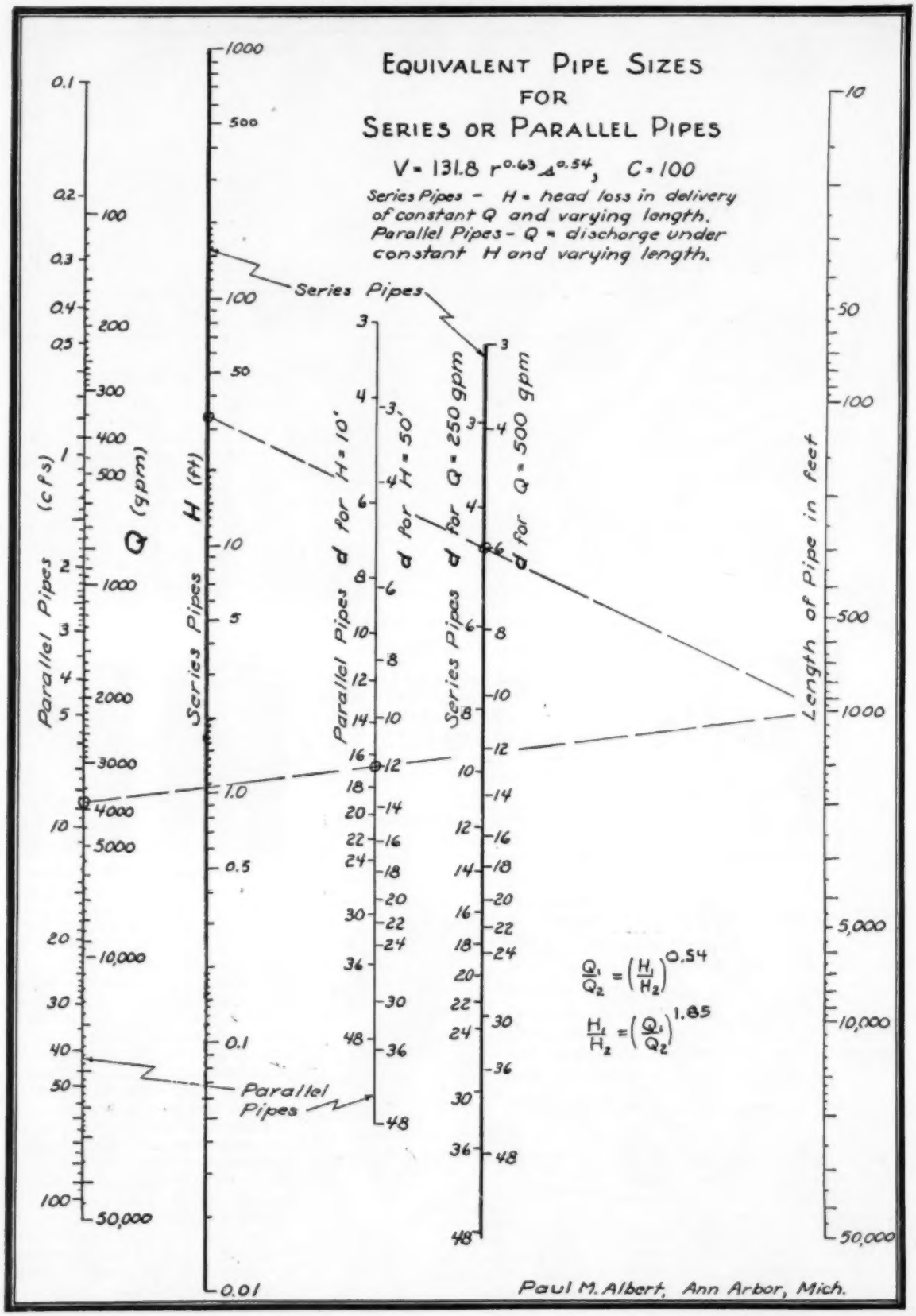
Using the Parallel Pipe Nomograph lines

Pipe	*Size*	*Length*	*H*	*Find Q*
ABCD	6 in.	1600 ft	10 ft	200 gpm
AD	8 in.	800 ft	10 ft	630 gpm
Both pipes			total	830 gpm

Assuming the diameter as 8-in for the equivalent pipe, connect 830 gpm and 8-in.-diameter and find the length to be 480 ft. This is the equivalent pipe and the head losses at other flows is easily calculated.

Series-Parallel

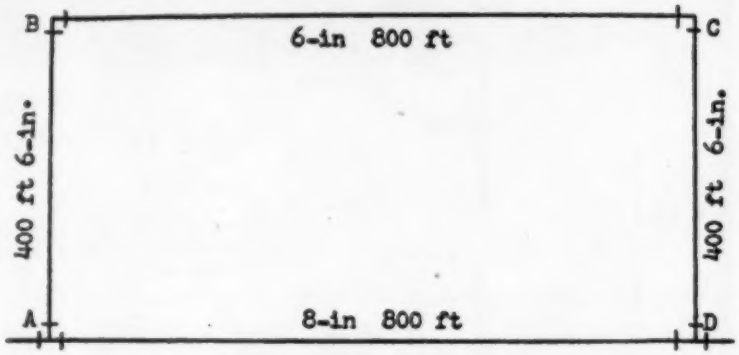
If, in the example of parallel pipes, one of the parallel pipes were to be three pipes in series (say as in the example of series pipes) the chart provides an unusually rapid means of simplification. Find the equivalent pipe for the series of three pipes. Use the series equivalent pipe and the remaining parallel pipe as two parallel pipes and find the parallel equivalent pipe. This is the equivalent pipe for the series-parallel group and further computations of friction and discharge through this network is simple.


EQUIVALENT PIPE SIZES
FOR
SERIES OR PARALLEL PIPES
$V = 131.8\, r^{0.63} s^{0.54}$, $C = 100$
Series Pipes – H = head loss in delivery of constant Q and varying length.
Parallel Pipes – Q = discharge under constant H and varying length.
Parallel Pipes Q (cfs)
Q (gpm)
Series Pipes H (ft)
Parallel Pipes d for H = 10'
d for H = 50'
Series Pipes d for Q = 250 gpm
d for Q = 500 gpm
Length of Pipe in Feet
Series Pipes
Parallel Pipes
$\frac{Q_1}{Q_2} = \left(\frac{H_1}{H_2}\right)^{0.54}$
$\frac{H_1}{H_2} = \left(\frac{Q_1}{Q_2}\right)^{1.85}$
Paul M. Albert, Ann Arbor, Mich.

Notes

The nomographs are based on a C-Value of 100. Where other C-values are to be used but all pipes have identical C-value the chart may be used without regard to the C-value and when the equivalent pipe is found it may then be evaluated in terms of the correct C-value.

Two equations in terms of H and Q are provided on the chart which may be used to compute flows at other head losses or head loss at other flows than those contained in the nomographs.



EXAMPLE 2 for pipes in parallel

Norman Howard is Dead

Norman J. Howard, retired Director of Water Purification and Sewage Treatment for Toronto, Canada, died May 2, 1956.

Mr. Howard, a native of Ireland, received his scientific education in England. Prior to coming to Toronto in 1911 he was assistant to the illustrous Sir Alexander Houston in the laboratories of the Metropolitan Water Board of London. In fact, Sir Alexander picked Howard for the Toronto job, and never regretted it.

Howard soon became a leader in the water purification field, both in Canada and the United States. He did some pioneering work in water chlorination and the unique Drifting Sand Filtration scheme employed by Toronto.

Howard became a member of the Am. Water Works Assn. in 1920, he served as chairman of the Canadian Section and as chairman of A.W.W.A.'s Purification Division. He served as National Director from Canada and became president of the Association in 1941. He was amongst the earliest to receive the Geo. W. Fuller Award in recognition of his contributions to the science of water purification. A.W.W.A. made him an Honorary Member in 1952.

Howard became interested in sewage treatment and served as chairman of the Canadian Institute on Sewage and Sanitation. He was sought after as consultant on matters pertaining to water and sewage treatment.

Few knew that "N.J." served as "Family Doctor" to the small population of the island on which the Water Purification Works is located. This was principally during winter when the island was cut off from the mainland by ice. He was as adept at delivering babies as at concocting a potion for a plain "tummy ache."

Tracy for President NEWWA; Karalekas as New Director.

The official Nominating Committee of the New England Water Works Ass'n. has chosen as their selection:

For President (1956-1957)

Edward L. Tracy, Chief Engineer
Vermont State Dept. of Health, Burlington, Vt.

For Vice-President (1956-1958)

Clarence L. Ahlgren, Ass't. Supt.,
Water Department, Manchester, N. H.

As Directors

(1956-1958)
Kenneth W. Robie, Supt.
Water Department, Brookline, Mass.
(1956-1959)
Peter C. Karalekas, Chief Engineer
Water Department, Springfield, Mass.

As Treasurer (1956-1957)

Wm. P. Melley, Commissioner
Water Department, Milton, Mass.

Voting is by mail prior to the 1956 Convention Sept. 16-19 at Bretton Woods, N.H. (Mt. Washington Hotel). These official nominations are tantamount to election and assumption of office at the closing of the convention.

You're middle-aged, alright, if you don't care where you go at night—just so you're home by 10 p.m.

Karl Kennison Retires, Stanley Dore Takes Over

Karl R. Kennison, Chief Engineer of the Board of Water Supply of N.Y. City retired on June 1st, 1956. His successor is Stanley M. Dore, former Deputy Chief Engineer.

Mr. Kennison holds honorary degrees as Doctor of Science from both Colby College and M.I.T. He was connected with the Water Dept. of Providence, R.I., before becoming

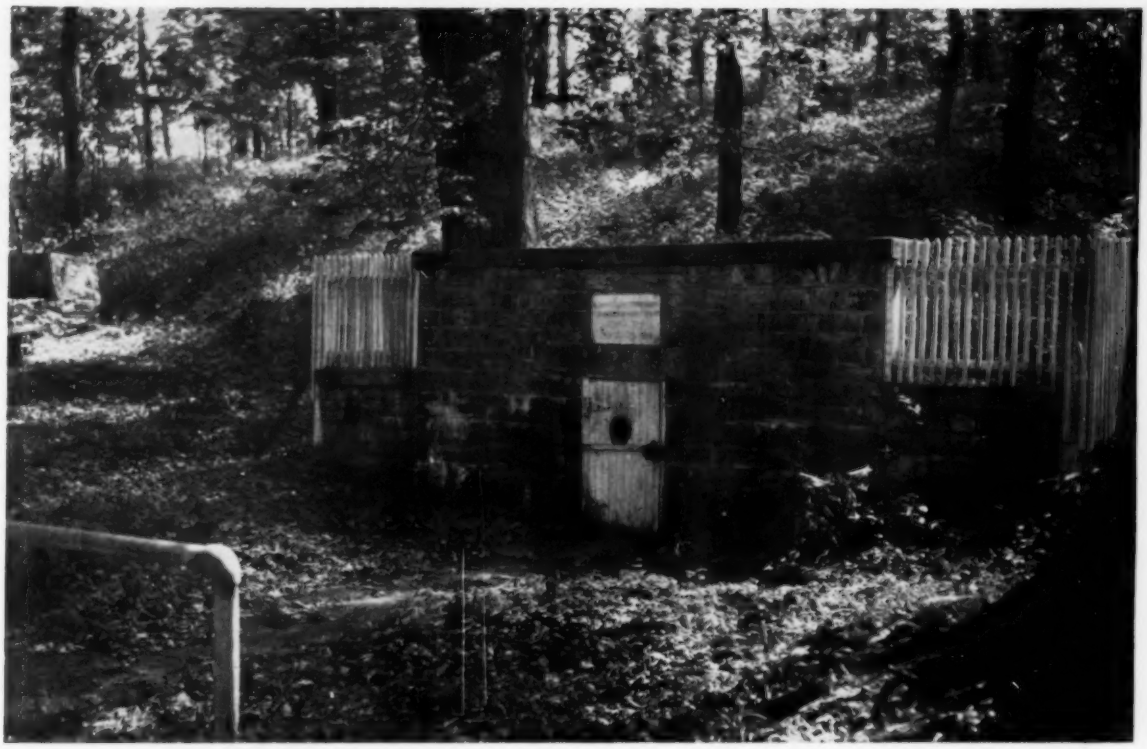
Karl Kennison

Stanley Dore

Chief Engineer of Metropolitan Water District of Boston, Mass. and then Chief Engineer of the N. Y. Board of Water Supply. To his credit Kennison has much in the way of unique design and inventions, including the Kennison Nozzle for flow measurements.

Mr. Dore is a graduate of Brown University. He too served on the design of the Providence, R.I., water supply. From 1928 to 1950 he served as deputy chief under Mr. Kennison with the Metropolitan Water District of Boston. For the next two years he was connected with the Alleghany Sewerage Authority of Pittsburgh, Pa. In 1952 he rejoined Mr. Kennison as Deputy Chief of the N.Y. Board of Water Supply.

Stepping up into Mr. Dore's former position is Mr. Geo. Spann who has been with the Board of Water Supply for 36 years.



MOUNTAIN spring source of earliest U. S. public water supply still serves the community

Early Pennsylvania Water Supplies

An interesting account of the early development of public water supplies in the Keystone State

OF ALL the states in the Union, it is likely that Pennsylvania ranks first in the percentage of the citizens furnished their water supplies through public systems. Of the 10,500,000 people in Pennsylvania, more than 8,000,000 are served through the 1025 public water works, through whose thousands of miles of pipelines some 1319 million gallons of water flow daily to meet consumer needs.

Of this total, approximately 900 million gallons serve the urban needs of 8,600,000 people. The urban use in Pennsylvania averages 102 gallons per day per person. Of the total of 1319 mgd delivered into public supply systems, 1207 mgd, or 92 per cent, is obtained from streams, lakes and ponds. The remainder is obtained from underground sources.

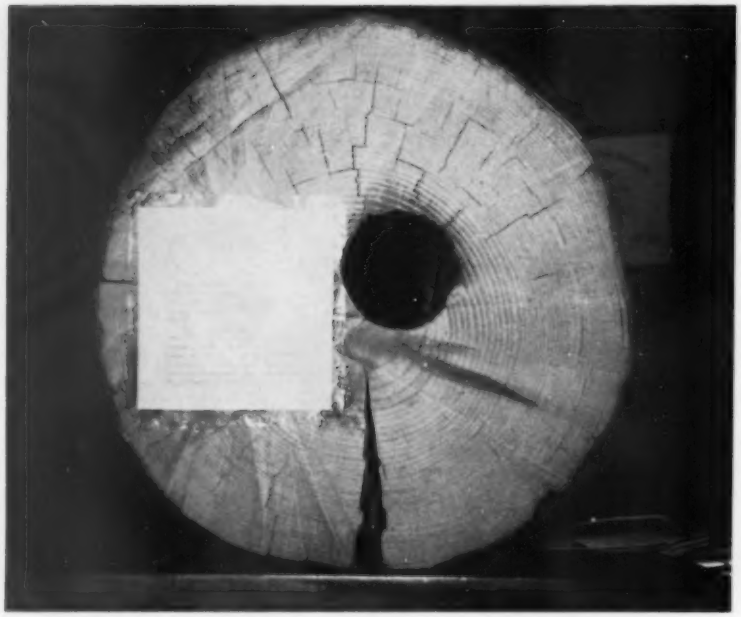
by HOWARD E. MOSES

Mr. Moses is Director Emeritus and Consulting Engineer of the Bureau of Sanitary Engineering, Pennsylvania Department of Health. His paper, presented at a Pennsylvania Water Works Operators' Conference, describes what may be the oldest public water works in the United States.

First Public Water Works

This in itself is an entrancing story; but this account is of early Pennsylvania water supplies. For the beginning, we go back more than 200 years to the first water works in the Commonwealth.

The oldest public water works in Pennsylvania, and perhaps in the United States, is that of Schaefferstown, Lebanon County (population 900). The exact date of construction is uncertain, but is fixed by good authority prior to 1750—one source of information indicates 1736. This town



SECTION of bored log pipe from original Schaefferstown water system

was formerly known as Heidelberg, later changed to Schaefferstown.

At that time it was just a village and, to supply the inhabitants with water, Alexander Schaeffer and Anna Engle, his wife, by deed dated July 16, 1763, transferred to the town of Heidelberg the perpetual use of a spring and water therefrom situated south of the village, to be held in perpetuity for that purpose.

Water was piped from the spring into the village through wooden pipe and delivered to two troughs, one on the main street and the other on a side street. The villagers had access to both these troughs for their water supply.

Later a modern-type pressure water system was installed in the town, but an interesting fact is that the spring water is still delivered to two street troughs. Presumably this water has been available ever since its first introduction.

M. N. Baker, author of "The Quest of Pure Water," in a letter to the author, states: "Apparently Schaefferstown was ahead of Boston by 16 years in having a public water supply provided. The Boston supply, however, seems to have been for fire as well as domestic purposes; but apparently in neither community was the water 'laid on' (as they say in England) to houses."

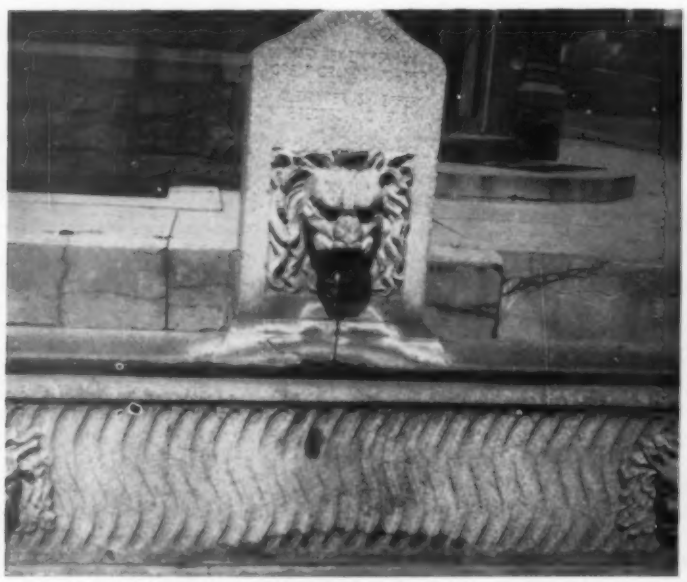
Bethlehem Works

Another early water works in Pennsylvania was that at Bethlehem, where the Moravian Brethren settled in March 1741. A large spring furnished a water supply, the water being distributed by water carriers or haulers.

In 1751 Christopher Christiansen was listed as one of the newly arrived settlers. He was by profession a millwright and by nature a mechanical genius.

In the spring of 1754 he commenced the erection of the first water works at Bethlehem. This included a pump made of lignum vitae, to which the spring water was conveyed by a conduit. The pump discharged through wooden pipe to a wooden reservoir or distribution tank built on the hill now occupied by the Moravian Church.

These pipes were bored hemlock logs. Because of the difficulty caused

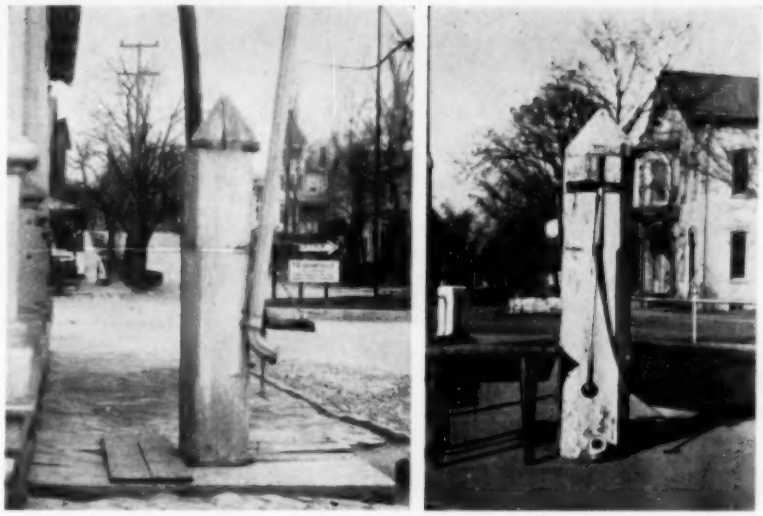


STONE water troughs have replaced original wooden ones of Schaefferstown public water supply

by the bursting of the wooden mains, an attempt was made to substitute 1¼-inch lead pipe made of sheet metal soldered along the edges and imbedded in a cement of pitch and brick dust laid in a gutter of hard burnt brick.

Christiansen also designed and built more powerful machinery, and on July 6, 1762, new pumps raised the water for the first time. Of interest to engineers is the fact that out of gratitude to the authors of the achievement, the record states that Christiansen received 30 shillings, and Christopher Demuth, his assistant, 15 shillings "for ye water running."

The new pumps were of iron; the motive power was furnished by an undershot waterwheel 18 feet in diameter and 2 feet clear in the buckets. A two-story building erected for the new works still stands, but shows evidence of a fire which occurred nearby. The cost of the entire works, including the tile-covered stone building, was £ 514 16s. 5d.



TYPICAL examples of early wooden pump on semi-public village water supply

Other Early Installations

After Bethlehem, there was a lapse of almost 50 years before the next public water works was installed in Pennsylvania. This occurred at Philadelphia in 1801. Seven years later a public water works was built at Beaver.

Some eight years after that a small water works was erected at Aaronsburg, in Centre County near State College. This had the added distinction of being the earliest water company incorporated in Pennsylvania by special act of Legislature (March 25, 1809), and was entitled "Water Pipes of Aaronsburg."

The second oldest incorporated water company now in operation is the York Water Company, chartered February 8, 1816, for supplying the city of York.

In February 1816, an Act of Legislature authorized the Northampton Water Company to engage in the business of supplying the public in Allentown with water. The organization began to function in the early 1820's.

The other water works in this group comprise Rebersburg, Easton, Chambersburg, Reading, Henrysburg and Columbia, the latter constructed in 1824.

Previous to 1850 there were 23 municipal and incorporated water supply systems installed. These each had a fairly complete system of water supply. Thereafter, up to 1910, a period of 60 years, 565 additional public water works were installed, making a total of 588 or approximately one-half the present number. This means that some 460 additional water works were built between 1910 and 1953.

Filtration

Previously it was stated that 92 per cent of the public water supplies in Pennsylvania are secured from surface sources. Inasmuch as many of these supplies are secured from the rivers and large streams subject to pollution, the matter of purification is of vital importance.

About 1869 the first real filter plant was built in the United States at Poughkeepsie, N. Y. The records of Pennsylvania's early filter plants are meager, but it appears that in 1889 one plant, considered the first, was built at New Bethlehem, Clarion County. Three years later the next plant was built at Beaver Falls, with Gettysburg two years after that in 1894. The Harrisburg plant was built in 1905 and was extended in 1923.

The New Bethlehem plant had only one filter with a daily capacity of 150,000 gallons.

Following 1894 many plants were installed, bringing the total up to 217. These have a capacity of over 1000 million gallons daily, and deliver filtered and chlorinated water to some 6,000,000 consumers, or approximately 60 per cent of the total population of the state.

Types of Filters

A word as to the kind of filters: In the early days of water purification large areas of sand, called slow sand filters, were generally used. However, American practice quickly departed from this type and developed to a high degree the mechanical or rapid sand filter such as is almost universally used.

Notable examples of the slow sand filters are found at Philadelphia and Pittsburgh, but in each instance other accessories have been added, such as pre-filters, which remove them from the former class of straight slow sand filters.

Some things of interest pertaining to this earlier period may be mentioned.

One is the installation of six filter plants of the Maignen type. These were scrubbers or roughing filters, generally consisting of sponge above stone. The first was built at Huntingdon in 1900; two were completed at two of the Philadelphia filtration plants (Lower Roxborough in 1902 and Belmont in 1909); and others were installed at South Bethlehem in 1904, Kittanning in 1905, and Lancaster in 1906.

Multiple filtration was used at Philadelphia in the Torresdale plant on the Delaware River. These filters were completed in 1909 ahead of the slow sand filters used at that place. Also, double filtration was completed in Philadelphia at the Queen Lane plant. At Steelton, pre-filters of the rapid sand type, completed in 1908, used anthracite coal screenings. The Steelton filters still use anthracite screenings (not the commercial product Anthrafilt).

In the earlier days there were several installations of pressure filter plants. Almost all of these have been converted into filters of the rapid sand type or replaced. Pressure filters currently are not approved by the State Department of Health for the filtering of public water supplies.

However, pressure filters do receive approval where they are to be used for water softening purposes or for the elimination of undesirable chemical constituents. Many of these also are approved for installation at swimming pools.

There are at least two instances where coagulation and sedimentation, without filtration, are being used for water clarification. One such plant is at Selinsgrove and another at Berwick.

Softening Filters

In the western part of the state, where hard water is encountered, a considerable number of plants have been installed for correctional purposes. There also are a number of installations for the removal of iron and manganese. These conditions are not so generally encountered in the eastern part of the state.

For the reduction of hardness, both the zeolite and the lime-soda processes are used, and in these rectification plants are to be found combinations of these processes.

Germicidal Treatment

The prevalent practice of treating public water supplies with a chemical germicide is less than 50 years old. The year 1908 marks the first one in which chlorination was used on any large scale in the United States. Copper sulfate, on the other hand, had been used quite extensively both here and abroad. In Pennsylvania, under the direction of Doctor F. Herbert Snow, then Chief Engineer of the State Health Department, it was first used in connection with the typhoid fever epidemics at Nanticoke and Scranton in 1905-1906. In succeeding years it was used at various times on unfiltered supplies, but generally in case of an emergency created by an epidemic.

Chlorination

The first use in Pennsylvania of chlorine on an unfiltered public supply was at Scranton about February 1909, following quite closely its first full-scale use in the United States.

In January 1911 a disastrous typhoid fever epidemic occurred in Erie. Late in the month (January 28, 1911) the water, which was then taken unfiltered from Lake Erie, was dosed with copper sulfate as a germicide, also under the direction of Doctor Snow. This treatment continued until March 15, 1911, when chlorinated lime was substituted for the copper sulfate.

Subsequently the practice of using chlorine, either in the form of chlorinated lime or chlorine gas, extended slowly. In 1912 it was used in only 13 public water works. After that, however, the growth was rapid, and today there are 522 installations on unfiltered water supplies, furnishing chlorinated water to about 2,250,000 people.

Refinements of Treatment

In the earlier years people were fairly well satisfied simply to have a public water supply available for use. Provided it was safe, they were not too demanding as to the appearance and to the presence of undesirable constituents.

That is no longer the case and the public insists on a palatable supply as well as a safe supply. It must be free from objectionable tastes and odors, reasonably soft, non-corrosive, and have a good appearance.

To this demand the water purveyors have been and are yielding, and there has thus arisen a new phase of water treatment either separate from or used in conjunction with filtration processes. It does not primarily effect the hygienic qualities of the supply, but certainly promotes its acceptability for household use. Consequently, in Pennsylvania there are water-softening plants as well as those installed for the removal of such undesirable constituents as iron and manganese.

A notable advance has been the installation of modern apparatus for the pre-treatment of water prior to filtration. This has greatly relieved operation troubles, as well as enhanced the quality of the product.

Another factor in this same field is the increasing amount of time being devoted to the matter of tastes and odors in public water supplies, along with which have been developed means of handling these vexatious features. Activated carbon early received a trial in Pennsylvania and is much in use today. Adaptation of the application of chlorine in the form of pre-, intermediate and post-chlorination has been found helpful. Chlorine dioxide has been the answer at some installations.

Fluoridation

Perhaps the latest feature of water works operation is that of fluoridation, whose purpose is to reduce the prevalence of tooth decay or dental caries. Some installations have already been made and others are contemplated. The Department of Health has made provision for the approval of such installations, provided the water consumers so desire and medical, dental and health board indorsements are secured. In this state there have already been nine such installations, the largest of which is at Pittsburgh. Philadelphia also is making an installation.

It is not the province of this paper to discuss the merits of fluoridation, but it is pertinent to mention that this innovation has met with opposition. From the historical standpoint it should be recalled that virtually the same pattern attended the introduction of other processes of water treatment. For instance, charges were made that the use of alum as a coagulant would have a detrimental effect upon the human organism; but perhaps the most vigorous opposition occurred when chlorine was first used and charges and

WINDLASS-type semi-public village water supply

counter-charges were made as to the virtue of chlorine as well as to the probable devastating effects of the use of a poison in the water we drink. Nevertheless chlorine made a place for itself by actual performance, and today there is practically no opposition to its use, although occasionally one hears a statement to the effect that an overdose is detectable in the taste and smell of the water. This probably is true on occasion, but other things cause similar results. However, people are more likely to demand the use of chlorine as a safety measure rather than to oppose its application to their drinking water supply.

The point of this discussion is that any proposed use of chemicals in public water supplies must establish itself by actual practice before it will be generally accepted, and that seems entirely reasonable. Otherwise, denial of its usefulness as a suitable means of treatment might well close the door to progress.

Emergency-type hypo-chlorinator frequently used in early years

Results of Advances

One last word as to the results of advance made in public water supplies, the best index of which is the reduction of typhoid fever and other waterborne diseases. Without taking complete credit for the reduction of typhoid, there is no doubt that protection of public water supplies has been the most potent factor.

In 1906 there were 3917 deaths resulting from typhoid fever, a rate of 54.8 per 100,000 population. Today the same rate is less than one death per 100,000 population.

This represents a saving of thousands of lives, as well as the attendant misery and expense incidental to sickness.

In the early days of the Department of Health, typhoid epidemics occurred. In fact, they were almost expected. Each year outbreaks both large and small happened in Pennsylvania; some were of tremendous proportions.

Table 1 shows some of the principal epidemics, where the cases amounted to more than 1000 persons and involved 100 or more deaths. However, the disease has not vanished and can recur as long as there are carriers abroad. Hence it would be unwise to relax our vigilance over public water supplies, and the utmost care and attention to the production of a safe and palatable water supply is needed today.

Tribute to Operators

In closing, tribute should be paid to the water works operators. Much of the success attained by Pennsylvania's public water works is undoubtedly due to the painstaking care and devotion to duty of those who actually operate our public water works and upon whom devolves the responsibility of supplying our citizens with water that is first of all safe, and at the same time is good to drink. Passage of years without serious outbreaks of disease ascribed to contaminated water is a commentary upon the zeal and devotion of all of those engaged in this fascinating work.

W&SW

TABLE 1

Some of the Principal Typhoid Epidemics in Pennsylvania

Location	Year	Number of Cases	Number of Deaths
Plymouth	1885	1104	114
Butler	1903-1904	1348	111
Scranton	1906-1907	1155	111
Erie	1911	1078	131
Troy*	1912	232	19
Grove City†	1914	201	16

* Population 1400.

† Preceded by probably 2000 cases of bacillary dysentery.

Mayor: remember that friend of yours with the Kiddy-Pool Co.? Well, he said that he'd make me a price on it that would be cheaper than fixing the leaks in the old reservoir. Maybe it don't hold as much, but the pressure's better.

Central States S&IWA Meeting *

THE 29TH ANNUAL Meeting of the Central States Sewage and Industrial Wastes Assn. was held in Green Bay, Wis. on June 20-22. This 4-state group now has a membership of 612 divided as follows: Illinois 264; Wisconsin 142; Indiana 120; and Minnesota 86.

Mayor Otto Rachals of Green Bay welcomed the conference and demonstrated the city's hospitality by issuing courtesy parking tickets to those who needed them.

Central States Brass

President	Vice Pres.	Vice Pres.	Secy-Treas.
W. E. Ross	R. W. Frazier	A. P. Troemper	G. F. Bernauer
Richmond, Ind.	Oshkosh, Wis.	Springfield, Ill.	Madison, Wis.

Volatile Acids

Prof. Gerald Teletzke of Purdue Univ. opened the meeting with a paper on volatile acids. He had been able to isolate from digesting sewage sludge, acetic, propionic, butyric, and valeric acids. The segregation of the volatile acids was done by chromatographic methods that were developed under the direction of Prof. G. A. Rohlich at the Univ. of Wis. The various volatile acids were found at all times in digesting sewage sludge. It is believed that all eventually break down to acetic acid and that the acetic acid is converted to carbon dioxide and methane.

John P. Slater, San. Engr. Indianapolis Sanitary District, told the construction story of the expansion of the Indianapolis plant. With colored movies and slides he demonstrated the difficulties encountered in the conversion of old plant tanks and buildings to serve new purposes. He mentioned the removal of the old fine screens and the utilization of the old primary settling tanks as preliminary grit chambers and bar racks. Numerous pictures were shown of the preaeration tanks with the mono-rail system for removal of grit from them.

Plastics

Edward H. Bryan, San. Engr., Dow Chemical Co. Midland, Mich., told about using plastics as: (1) packing, (2) foam for insulation, (3) pipe, (4) filter blankets, (5) tank and pipe lining, (6) clay pipe gasketing, and (7) tower packing (aeration units and trickling filters). He pointed out that the cost of plastics per pound is inversely proportional to the quantity being manufactured. It is apparent that these new materials have wide application in the fields of sewage and industrial waste disposal.

Fox River Valley

One session was spent in problems of stream sanitation in the Fox River Valley. A. J. Wiley presented a paper, "Cooperative State-Industry Stream Studies in Wisconsin"; it was co-authored by B. F. Lueck, R. H. Scott, and T. F. Wisniewski. The lower Fox River is 39 miles in length and in this distance there are 14 power dams, many cities, villages and industries. In the survey described by Mr. Wiley samples were taken throughout the length of the stream and analyses were made for B.O.D., D.O., deoxygenation rates, suspended solids, and organic matter resistant to biological degradation. This latter analysis was made by the Folin and Denis test for the aromatic hydroxyl group. The river apparently received as much as 400 tons of organic matter daily from natural and man-made wastes and it seems likely that a very substantial portion comes from natural sources such as the growth of algal blooms in Lake Winnebago.

N. L. Malcove, Tech. Supt., Marathon Corp., Green Bay, discussed "Industrial Wastes on the Lower Fox and Their Treatment". Mr. Wiley had said that there were 14 dams; Mr. Malcove said that there were 15, nine government owned and six privately owned and then he further stated that there are 18 locks that are operated by the federal government. Certainly, there are numerous interruptions to the flow of water in the Fox. In the thirty-nine miles of stream there are 40 mills (21 paper, 6 groundwood, 4 sulphite, 3 rag, 4 deinking, 1 Kraft, and 1 semi-chemical). In addition there are: one beet sugar plant and one animal rendering plant. The annual paper mill production is about 725,000 tons and the combined annual pulp production is about 425,000 tons. A few of the mills divert their strong wastes to the city sewers.

The sewage treatment problem on the Fox River is not completely solved with the ten plants that are now in operation at (1) Appleton, (2) Kimberly, (3) Little Chute, (4) Kaukauna, (5) Wrightstown, (6) DePere, (7) Green Bay, (8) Neenah-Menasha, (9) Hickory Grove

Federation Brass

President	Exec. Secy.
Geo. A. Martin	Dr. R. E. Fuhrman
Green Bay, Wis.	Washington, D. C.

Award	Fed. Promoter*
I. G. Knoebel	Jake Klein
Belleville, Ill.	Sheboygan, Wis.

*Selling Los Angeles

* Reported by Don E. Bloodgood, Prof. San. Engr., Purdue Univ. and Editor, *Industrial Wastes*.

Sanitarium, and (10) Fort Howard Paper Company. This statement was made by Bruce Stevens, District Engineer of the Wisconsin Board of Health. The village of Combined Locks contracts with Kaukauna to treat the sewage from the village. Some of the other smaller communities contract with cities and are provided sewage treatment. Five of the communities have installed sewage plants where chemical can be applied, one has an activated sludge plant and two have trickling filters (high rate). Table I shows the degree of treatment being attained in each sewage plant when high chemical dosages were being applied in the chemical coagulation plants.

The survey showed that "acceptable reduction in pollution cannot be expected while the plants are being operated with chemical coagulation and settling facilities only".

Inspection Trips

Afternoon trips were made to: (1) Marathon Corporation, Northern Paper Mills Division Sulphite Liquor Evaporate and Burn Plant; (2) Charmin Paper Mills Yeast Plant and (3) Green Bay Metropolitan District Sewage Treatment Plant.

The high-rate trickling filters at the Green Bay are six feet deep and made up of large sized stone. There does not seem to be much growth rate. No filter files were visible but the larvae floating on the secondary settlers were said to be psychoda. George Martin, Supt., has a very immaculate plant.

At the Charmin Paper Mills yeast plant the sulphur dioxide is stripped from the waste liquor prior to neutralization. After these processes the liquor goes to the fermenters where the yeast is grown. The yeast is removed from the media by centrifuges. The remaining liquid from which most of the wood sugars have been removed is then hauled away in tank trucks and applied to the surface of gravel roads as a binder and for dust control.

At the Marathon Corporation plant the sulphite liquor is evaporated to a liquor containing 65 per cent solids. It is then fed into the fire box of a powdered-coal-fueled boiler where it is utilized as fuel.

The annual banquet was held in the Northland Hotel. Federation President George Martin and Executive Secretary Ralph Fuhrman were presented to those in attendance. Professor George J. Schroepfer received the Arthur Bedell Award for outstanding service to the CSSIWA. Charles R. Griffith of the Dana Corporation of Fort Wayne received the award for the best paper of the year. I. G. Knoebel of Belleville, Ill. received one of the awards for the best annual reports submitted, and Paul Brunner of Fort Wayne, Ind. received the other.

Programmers

G. E. Teletzke, Purdue Univ. — W. Hogenson, Rochester, Minn. — E. H. Bryan, Dow Chem. Co. — J. P. Slater, Indianapolis, Ind.

Operators' Breakfast

At the well-attended Operators' Breakfast much of the discussion was devoted to detergents and their effect on sewage plant operation. C. C. Larson of Springfield, Ill. said that he had never had any trouble until one of the soap companies left a sample of detergent in every home and then the next day after the free distribution he had foam all over his activated sludge plant.

Professor Rohlich said that their studies at Wisconsin had shown that some activated sludge plants where there was foaming with 500 ppm of mixed liquor solids did not have foaming when the solids were raised at 1000 ppm, but that they had found other plants where there was foaming at 1000 ppm mixed liquor solids but this foaming would stop when the solids were raised to 1500 ppm. Paul Brunner of Fort Wayne has given up fuel oil as a control of foaming and is now using water sprays. There still seems to be a general feeling that detergent manufacturers put a foaming agent in their product to impress the housewives. The truth of this should be established.

In the discussion on cleaning digestion tanks it was brought out that designing engineers should provide suitable ports in the digestion tanks to make the cleaning process as easy as possible. Frank Vilen of Kenosha, Wi. believes that digestion tanks should be cleaned every three years.

Walter Hogenson of Rochester, Minn. led the discussion on odor problems in sewage treatment plants. Ronald Kronewitter of Mishawaka, Ind. believed that ozone can be used effectively in controlling odors arising during sludge drawing.

E. J. Beatty of Urbana-Champaign, Ill. presented some of the problems experienced in annexing areas to sanitary districts. He has found groups petitioning to get into his sanitary district and when they were in they immediately started a petition to have their area removed from sanitary district jurisdiction.

New President W. E. Ross adjourned the meeting at noon on Friday. There had been 183 men and 40 women registered, and all were grateful to the manufacturers who had made the social periods so enjoyable.

Attending meetings of the CSSIWA is always enjoyable. Additional benefits can be had by visiting sewage treatment plants on the way to and from the meeting. It was the writer's good fortune to be able to stop at the plants at Chilton, Sheboygan, New Holstein, Kiel and Belgium, Wis.

Jake A. Klein of Sheboygan was enthusiastically working on everyone to try to get as many as possible to take the train excursion to the Federation meeting in Los Angeles.

Inspection Trips in Wisconsin
Green Bay — Sheboygan — Chilton — New Holstein

Industrial Waste Ordinances—Part 1

General principles, responsibilities and methods of application

by DEAN M. TAYLOR

Mr. Taylor is Senior Sanitary Engineer, Engineering Division, Department of Public Works, Cincinnati, Ohio. In this article, he deals with the responsibilities of industry and of the enforcing agency as well as with the general methods of complying with the provisions of industrial waste ordinances.

THE SOUNDNESS of an ordinance is tested by its application. Original mistakes crop up to plague those applying it. What seems perfectly clear at first may turn out to be a point of controversy later on. Experience often reveals omissions and indicates necessary corrections. The advantages of short form over long form ordinances are thus brought out. With a short form the person or persons administering the industrial waste ordinance can change the rules and regulations when necessary[1]. For example, the Industrial Waste Ordinance of the City of Cincinnati, Ohio, has been amended twice since adoption in 1953.

It takes time to put an industrial waste ordinance into operation. If representatives of industry have participated in discussions of the program from the beginning they are better able to participate in the final program since they can anticipate their responsibilities and take steps to meet them. Much preliminary information is needed to initiate the program and all participants should be primed to establish policy and procedures for reasonable deadlines. Experience has shown the desirability of establishing dates for compliance. Some industries always wait for municipal government to take the initiative. Of course they don't like to increase their overhead but industrial waste disposal is a community problem which must be solved by democratic community effort.

Types of Ordinances

Industrial waste ordinances may be placed in two general categories: (1) those controlling discharge of wastes to sewers; and (2) those providing service charges in addition to control of discharge to sewers. Probably all existing industrial waste ordinances contain rules and regulations defining the conditions of acceptance or refusal of certain wastes but few ordinances provide for special service charges for industrial wastes, above and beyond the usual volume charges.

There are many phases to a program of special service charges. As a whole it is complex and the history of its development is relatively short. So many plans have been proposed that public officials, inexperienced in such matters, have been confused. When they come to the question of special charges for industrial wastes, they throw up their hands and say they don't know how it can be done. This is the time to seek advice and work out the problem in a practical manner. Each community should study its own needs and develop an ordinance to meet them.

Responsibility For Application

It may be said that the municipal government or regulatory agency is responsible for applying an industrial waste ordinance but actually this responsibility is a matter of enforcement. If industry assumes a positive attitude and moves to meet the requirements of an ordinance, then the government agency will not have to take police action. When all parties can meet with mutual understanding and respect, application runs smoothly and goals are reached.

When an industrial waste surcharge is to be applied, the enforcing agency will probably move quickly to collect fees. Speed will also be exercised if prohibited wastes are seriously affecting public property, operations, safety, health, or welfare. Industries will also be very much concerned with surcharges, particularly when they receive their first bills for same. If industrial management is alert it will initiate study of its industrial waste problems as soon as the ordinance is passed. It will also familiarize itself with all the requirements of the ordinance so that it can meet them on schedule. Enforcing agencies should initiate such programs with patience but there is a limit to procrastination and downright lack of cooperation. Moreover, ignorance of the law is no excuse for nonconformance.

Some industries have serious industrial waste problems, others do not, Industrial waste disposal is an operation to be reduced to the lowest possible cost like any other operation in an industry. Smaller industries may prefer to let governmental agencies take all the initiative because they think it will be cheaper. This may be false economy because the enforcing agency is responsible for applying the rules and regulations, not working out the industry's problems. Employees of the agency can make certain suggestions, but professional ethics place certain limits on professional services.

Application by Industry

An industrial waste ordinance can present many problems to an industry. It can also solve certain problems for the same industry. Therefore, it is important that each industry study its own situation and evaluate it. This is particularly true when there are sewer service charges for wastes in addition to certain prohibitions for them.

Some industries have serious waste disposal problems; others have relatively simple ones. Ordinarily, the size of the company determines the quantities of wastes rather than the qualities. When management understands the objectives and directives of an industrial waste ordinance, it can take realistic steps to meet its requirements. If competent people are

Ed. Note: In an article in *Water & Sewage Works* (*April* 1956, *p.* 173), Mr. Taylor discussed the policy, legal, financing, engineering and technical requirements inherent in establishing ordinances for the control of industrial waste discharge into municipal sewers. In Part II of this article, Mr. Taylor will discuss Cincinnati's experience in applying its industrial waste ordinance.

made responsible for a waste disposal program and are backed by management, then reasonable progress should be made. If a company does not have technical personnel who can carry out an effective industrial waste program, then thought should be given to employing a competent consultant, for which industry should pay fees comparable to services rendered. The consultant's services should be commensurate with needs.

Industrial Waste Survey

Knowing your own problem is axiomatic. Some companies know much about their wastes, others do not. After summarizing the known facts, action can be taken to obtain the necessary additional information.

Making an industrial waste survey is a must. It reveals both characteristics and source of the wastes and shows or indicates proper methods for elimination or disposal. Articles describing industrial waste surveys and valuable sources of information[2-6] and several good textbooks describe industrial processes and equipment, wastes produced, and practical methods for wastes disposal[7-11].

Persons making an industrial waste survey have flow diagrams for all manufacturing processes as well as sewer lines in order to select proper gaging and sampling points. Gaging can be a difficult problem, praticularly in old plants with many hidden sewers. It may be worthwhile to relocate sewers and build new gaging stations to obtain data on a permanent basis. It is necessary to study the requirements of the Industrial Waste Ordinance to determine what waste constituents should be selected for analysis. In addition, the manufacturing processes should be studied for selection of other constituents of importance. Industrial wastes present many problems in analytical chemistry. Care should be taken in selecting methods acceptable to the regulatory agencies and consistent with good practice. If the samples are sent out to commercial laboratories, analytical methods should be stipulated.

Making the survey involves many technical details. Failure to consider seemingly unimportant details may invalidate much data. Production and operational schedules should be studied to determine proper survey times. It may be desirable to obtain information for abnormal as well as normal conditions. The length of the survey is important, for representative values and should extend over full operational cycles (at least 1 week). Both grab and composite samples have value if properly interpreted. It has been customary to collect 24-hr. samples composited in proportion to flow. Accurate hydraulic measurements yield necessary, valuable information. The sampling interval should never exceed 1 hr and more properly should be of the order of 10-15 min. In general, the shorter the time interval the more truly representative will be the sample.

Sampling techniques and equipment are also important in obtaining representative samples. Manual sampling is practical for limited work, but automatic sampling is more useful for extensive work. Comparable data may be needed to substantiate specific automatic sampling situations.

Handling of samples may be very important, depending upon the nature of the wastes and the analytical determinations to be made. Samples for such analyses as BOD, phenols, and cyanides must be preserved properly. Finally, the laboratory work should be done in the prescribed manner under proper conditions, by trained technicians.

Unfortunately, many industries may obtain erroneous data from their original waste surveys. In Cincinnati this was found to be largely due to improper methods of gaging, sampling, and laboratory analysis. Incompetent or inexperienced personnel cannot be expected to obtain representative data. Some of the more common errors are: improper selection, installation, maintenance, and reading of flow measuring devices; taking only one or a limited number of grab samples; failure to composite samples according to flow rate; sampling only one of several points of discharge to sewers; failure to sample over representative time periods; improper selection of sampling points; failure to sample at short enough time periods; improper sampling techniques; and improper laboratory methods and techniques.

In Cincinnati, engineers of the Sewage Disposal Section examined all waste survey data furnished by industries. Whenever differences between City and company data appeared, Sewage Disposal Section Engineers reviewed all technical procedures with representatives of the companies. It has been possible to establish standards of procedure consistent with the best principles of engineering and laboratory practice.

Conformance With Ordinance

After the waste survey has been made, industry should determine its status with respect to the industrial waste ordinance. If the survey indicates changes for greater efficiency, it is reasonable to say that management will make them. But if it shows nonconformance with the ordinance, then it may be necessary to make many important decisions.

If it can meet certain requirements, industry has the choice of discharging its water-carried wastes to public sewers or directly to waters of the state. The choice is usually a matter of economics, but it may involve political considerations or public relations. Sometimes it is feasible to segregate wastes and discharge unpolluted water to waters of the state and polluted water to public sewers. When a service charge is levied for volumes of water discharged to sewers, it is practical to discharge as much water as possible to waters of the state. On the other hand, it may be cheaper to discharge all wastes to public sewers than to segregate sewers or pretreat the wastes. If an industry has been discharging wastes to the public sewers before the industrial waste ordinance was passed and has no access to waters of the state, then it has no choice but to meet the requirements of the ordinance.

Meeting the prohibition requirements of an industrial waste ordinance usually is a matter of reducing waste constituent concentrations. There are a number of methods available: reuse of water and materials; storage and equalization of waste flows; good housekeeping; process and equipment changes; proper mixing of wastes; recovery units; and waste treatment. The last method may be applied at the source, at the point of plant discharge, or any place between.

Numerous methods are employed for financing sewage disposal systems. When general taxation funds are used, industries only have to worry about concentrations of certain restricted waste constituents, if there are any such restrictions. When there are only volume service charges, industries can reduce water usage to a minimum and forget about concentrations provided there are no special prohibitions. When there are service charges for both volumes and concentrations of certain constituents (usually suspended solids, BOD, and chlorine-demand), then industries have real problems trying to balance the one against the other so as to reduce the total cost. All of the previously mentioned waste-reducing methods can be used and when data from a waste survey are available, it is possible to arrive at a practical minimum cost.

Industrial Waste Treatment

Most published articles and textbooks on industrial waste deal with specific problems and their solution. The information is usually classified according to industries. Industrial waste engineers can obtain valuable information from such literature, but they would do well to study the basic principles of industrial waste treatment processes and equipment. Many treatment problems are similar but not exactly the same.

Laboratory data should be put through the pilot plant stage before full scale applications. Before purchasing equipment, considerable thought should be given to the overall cost, including initial, operational, and maintenance costs. The reliability of the manufacturer is also important. It may be possible to try out a small-scale unit.

Industry in the Metropolitan Sewage Disposal Area of Cincinnati, Ohio, has taken positive measures in waste treatment as evidenced by the expenditure of 6-7 million dollars in the period from 1953 to present. Most of this money was spent during the first year of application of the Industrial Waste Ordinance when a bonus clause permitted the first year's surcharges to be based on waste surveys made at the end of a one year grace period.

Application by Local Govt.

Local policies regulate methods of application. Consequently, there is no specific method for initiating action and applying regulations. Local officials will save time by dealing directly with management of industry and explaining methods of application.

Operational requirements are determined by the size of the community, the extent of industrial development, and the scope of the industrial waste ordinance. Small communities usually have few industries and, conversely, large ones usually have many. Since ordinances apply only to plant effluents, the number of industries is more significant than their size in applying the ordinance. Adequate, competent personnel and operating funds must be made available to initiate application of an industrial waste ordinance, if it is to be effective. Appraisal of the program will show future needs.

Preliminary Steps

An industrial waste ordinance may be applied to any new or existing sewage disposal program. If there is no existing sewage disposal system or treatment plant, more time may be given to the details of application. This is particularly true with prohibited wastes which would inhibit or prevent certain treatment processes. Depending on the size of the community and the extent of industrial development, there is great advantage to preliminary investigations.

Some of the helpful preliminary steps are: (1) study of the literature; (2) review of directories; (3) sending out questionnaires; and (4) making preliminary field surveys. Where a new treatment plant is under construction, the municipality can develop and apply the industrial waste ordinance before operation starts. The interim period gives time to work out the "bugs". Part II of this article will include examples of how these preliminary steps were applied in Cincinnati.

Controlling Discharge to Public Sewers

Much has been written about control of industrial wastes to public sewers. Manual of Practice No. 3, titled "Municipal Sewer Ordinances" by the Federation of Sewage Works Associations, is a valuable guide. Such control has four major objectives: (1) to protect the sewage collection system; (2) to protect operating personnel; (3) to protect the treatment plant; and (4) to meet effluent or stream standards.

There is considerable controversy about permissible limits for certain waste constituents. This is natural because sanitary engineers are still in the process of finding the true effects of these materials on sewage disposal systems but more factual data may be obtained in time.

Protecting the sewer system is essentially the task of preventing discharge of these industrial wastes which will: corrode or erode the sewers and appurtenances; clog the sewer system; cause explosion or fire hazards; or pollute storm sewers. Protection of operating personnel is accomplished by prohibiting discharge to sewers of toxic materials and explosive or flammable materials. Protection of the treatment plant is a matter of preventing damage to structures and equipment, and to their operation and preventing interference with sewage treatment processes. Protecting the treatment plant effluent to meet certain stream standards generally amounts to control of specific soluble constituents entering the plant. Calcium, magnesium, chlorine and fluoride ions will go right through a plant and give problems to downstream water users.

There is an advantage to requiring permits for discharge of industrial wastes to public sewers. Companies would be required to report quantities of wastes discharged. Duly authorized employees of the controlling agency should be permitted to enter such properties as may be necessary for the purpose of inspection, measurement, sampling, and testing wastes. Information can be kept current and control exercised by requiring that plans, specifications, and other pertinent information relating to pretreatment facilities be submitted for the approval of the authorized official or officials. There is also an advantage to requiring periodic operational records for such facilities.

When industries have been classified according to types of production and wastes, it is possible to outline methods of controlling troublesome wastes. Companies can be placed in four general categories: (1) those producing wastes prohibited from sewers; (2) those producing wastes to be limited in concentration before discharge to sewers; (3) those producing wastes to be limited in both volume and concentration before discharge to sewers; (4) those producing wastes to be limited in concentration as they arrive at the sewage treatment plants.

Field surveys are mandatory. They show actual operating conditions and permit on-the-job discussions with company officials. Also, they are the only means of gaging, sampling and testing by governing officials. All decisions, directives, and reports should be confirmed and clearly stated in letters for future record. There is nothing more difficult or frustrating than trying to solve knotty problems at future dates with no written records.

Checking wastes prohibited from sewers is a continuous job. Even though management of industry has the best intentions, chain-of-command can break down and workers carelessly discharge prohibited wastes to sewers. Systematic inspection of sewers will often reveal offenders. Tracing sewage treatment plant problems back to sources of industrial wastes can be difficult. Some detection can be done by visual inspection, but analytical methods are more convincing. Waste source files are valuable guides.

Controlling concentrations and quantities of waste constituents discharged to sewers and arriving at treatment plants involves sampling and gaging procedures. Some ordinances base limitations on grab samples while others require 24-hr composites. Both methods have value, depending on circumstances. Automatically recording instruments and

samplers are valuable for such work.

Controlling agencies should be prepared to furnish all the necessary equipment and facilities for survey work. One city requires companies to pay for all gaging, sampling, and testing costs[12]. Testing equipment, laboratory facilities and transportation should be commensurate to scope of work. Volumes of work will vary for each program but quality should not be sacrificed for expediency.

Special Service Charges

Because it is impractical to sample and gage wastes from residences, stores, business houses, and public buildings, the usual practice is to establish base values for "normal" sewage and levy surcharges on those wastes exceeding "normal" sewage in terms of certain waste constituents (such as suspended solids, BOD, and chlorine-demand). Volumes of wastes can be measured at their point of discharge to sewers but they are usually determined by water consumption meters. Proper exemptions should be made for water not reaching the sewers (cooling towers, products, boiler blow-downs, etc.). Concentrations of wastes can be estimated from average values for similar industries but the only truly accurate method is to gage and sample the wastes from each specific company. Wastes from certain companies vary considerably, so they have to be checked periodically. Certain industrial associations may base surcharges on units of production, such as barrels of beer, pounds of linens to be laundered, or pounds of skim milk processed.

The task of making industrial waste surveys to establish surcharge rates is similar to that described above for industries. The main difference is that each company surveyed presents new problems for sampling and gaging. All waste line connections to public sewers have to be located and much engineering ingenuity is required to solve gaging problems. Manual sampling for at least five to seven 24-hr days is usually required. When survey programs are initiated, few if any companies will have proper sampling and gaging facilities available for controlling agencies. Some industrial waste ordinances require construction of suitable sampling and gaging stations within certain time periods after passage. Others provide appointed authorities with powers to require construction of same. This latter method allows greater flexibility of application and gives more time to companies with serious problems.

It is important to establish certain operational criteria. Sewage surcharges will be scrutinized by companies subject to them, and it will be necessary to always be on firm ground. Consistent policy will be necessary to maintain equity and good public relations. Standard Methods for the Examination of Water, Sewage, and Industrial Wastes[13] has been universally accepted as a standard for laboratory work. The inadequacies of this book can be met with the use of acceptable, additional procedures. All details, such as sampling and gaging procedures, compositing of samples, and methods of computing average values should be clearly established and explained to those concerned.

Summary

1. Much work is required to apply industrial waste ordinances, particularly when there are sewer service charges in addition to regulations controlling discharge to sewers.

2. The governmental agency is responsible for enforcement but industry should share the responsibility of application.

3. Industry will benefit from a progressive industrial waste program. After making thorough waste surveys it is possible to compare existing conditions with the requirements of the industrial waste ordinance. Cost studies can be significant where there are sewer service charges or surcharges.

4. Helpful preliminary steps in applying an ordinance are:
   (1) study of the literature and reports
   (2) review of directories
   (3) sending out questionnaires
   (4) preliminary field surveys.

5. Discharge of industrial wastes to public sewers is controlled to:
   (1) protect the collection system
   (2) protect operating personnel
   (3) protect the treatment plant
   (4) meet effluent or stream standards.

6. Companies subject to industrial waste control can be placed in four general categories:
   (1) those producing wastes prohibited from sewers.
   (2) those producing wastes limited as to concentration before discharge to sewers.
   (3) those producing wastes limited as to both volume and concentration before discharge to sewers
   (4) those producing wastes limited as to concentration as they arrive at sewage treatment plants

7. The determination of sewer service charges and surcharges requires accurate gaging, sampling, and laboratory practices.

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Milwaukee Plans 25% Water Rate Increase

Otherwise Revenue Bonds Impossible

Milwaukee's council voted 18 to 0 to petition the State Public Service Commission for a 25% increase in water rates.

(Ed. Note: In Wisconsin the Public Service Comm. exercises the same jurisdiction of publicly owned utilities as it does in the case of privately owned utilities.)

The decision to seek a rate increase was made after the city's waterworks consultants, Black & Veatch of Kansas City, Mo., reported that the waterworks' present financial situation would not permit the issuance of revenue bonds to pay for plant expansion.

A revenue bond issue of $5,000,000 is set up in the 1956 budget for construction of water mains, reservoirs, booster pumping stations and other facilities. The objective is improved quality of Milwaukee's water service, such as adequate 24-hour pressures and lifting of water use restrictions, which have made no friends for the Milwaukee Water Department during the past several years.

11th Purdue Industrial Waste Conference

Highlights of papers on municipal problems introduced this year into the program

THE ELEVENTH Annual Industrial Waste Conference at Purdue University on May 15-17, 1956 did credit to its predecessors, its director and its sponsors. Of particular interest to readers of *Water & Sewage Works*, were a series of papers devoted to industrial waste problems and their relation to municipal sewage treatment operations. It is these papers which are reported here. (Papers on air pollution and other industrial waste problems are reported in *Industrial Wastes*).

As heretofore, the Conference was supervised by its director, Prof. Don E. Bloodgood, and was sponsored by Purdue University Civil Engineering Dept., the Indiana Stream Pollution Control Board, Indiana Conservation Dept., the Ind. Sect. AWWA, and the Cent. States Sew. & Ind. Wastes Assn. More than 300 persons attended to hear the more than 50 papers and talks.

Water Management in Industry

The opening paper of general scope was prepared by K. S. Watson, Consultant, General Electric Co., Schenectady, N. Y. and dealt with "WATER MANAGEMENT IN INDUSTRY" as a means of reducing costs and controlling wastes. Mr. Watson was in Europe and his paper was read by C. H. Fair of the General Electric Co. Since water management in industry often results in reduced load on municipal systems, Mr. Watson's paper has considerable interest to *Water & Sewage Works* readers.

Water management includes control of water in industry from source of supply, through process operations to treatment of wastes and discharge of final effluent. Any industry interested in reducing costs, reducing waste discharge, or reducing waste load on municipal systems should have one person assigned to water management.

Smart water management makes water work two or more times as it passes through a plant, utilizes recirculation systems and water reuse systems. Clean waters are segregated from dirty waters for reuse or for discharge without treatment.

Utilization of Waste Waters

One paper of considerable interest was on "DIRECT UTILIZATION OF WASTE WATERS" by Prof. R. C. Merz, Univ. of Southern California, Los Angeles, Calif. Prof. Merz reported on a study of some magnitude on the practice of waste utilization in the United States.

This study covered reuse of wastes industrial agricultural, recreational,

Director
Prof. Don E. Bloodgood

and ground water injection purposes. Mining and metallurgy have a marked reuse practice. More than 100 industries reclaim wastes and 15 industries utilize municipal sewage treatment effluents.

Agriculture has found use for sewage effluents, particularly in arid regions. This is a safe and satisfactory method of disposal to prevent pollution. It also saves water and provides plant food. Factors of percolation, use of crops, climate, runoff, and evaporation have a bearing on the agricultural use of sewage effluents.

Pre-irrigation can use raw sewage but vegetables must have treated sewage. Crop yields vary with water applied and nutrients in the waste. The mineral content is important, as are health department requirements. Recreational uses of treated wastes include golf course irrigation and recreational park lakes as at Golden Gate State Park.

Most interesting phase of waste reuse is that of ground water injection to recharge depleted aquifiers. Experiments in California on ground water spreading indicate a future for this practice. Use of injected waste water to provide a fresh water barrier to salt water intrusion has been quite successful.

Two factors mitigate against the rapid acceptance of sewage effluent reuse, particularly for ground water injection; these are cost and aesthetic attitudes of the general public. (This paper which reviews the applications of waste water reuse by industry is to appear in full in *Water & Sewage Works.*)

(The following highlights from papers presented were prepared by David H. Howells, San. Engr., U. S. Pub. Health Service, Chicago, Ill.)

Tastes and Odors in Drinking Water

A progress report on "THE CAUSES OF TASTES AND ODORS IN DRINKING WATER" was presented by R.D. Hoak, Mellon Institute, Pittsburgh, Pa. This paper dealt with studies which have been made of the part played by nature as a source of phenolic taste and odor producing compounds in raw water supplies.

Of all industrial wastes, none has been held responsible for taste and odors in water more than phenol. One factor contributing to this belief has been the development of critical analytical methods for detecting the phenolic compounds. While most research has been carried out on pure compounds, the actual taste and odor producing substances have been found to be mixtures of many different aromatic hydrocarbons. A slight modification of the molecular structure of any of these substances will cause a significant change in its taste and odor producing characteristics. This was illustrated by data which showed wide variation in the odor threshold concentrations between such closely related compounds as the ortho, meta, and para forms of phenol and chlorophenol.

The presence of a phenol equilibrium in unpolluted surface waters as a result of extra-cellular hydrolysis of complex organic compounds by bacteria was mentioned as a highly probable phenomenon. Phenol concentrations ranging from 3 to 24 ppb have been found in surface waters remote from industrial and human activity. Some aquatic plants have

been found to release phenolic compounds as part of their life processes. A recent stream survey by the Steel Industry Committee of the Ohio River Valley Sanitation Commission disclosed that the total phenol waste load discharged to the stream by all steel mills located in the watershed was considerably less than the total phenol in the river. This was interpreted to mean that much of the phenolic type compounds came from other sources such as the decay of vegetable matter.

Experimental laboratory studies involving the aseptic fermentation of oak leaves in polyethylene bags were conducted. During the 75-day experimental period, the phenolic compound concentration of the resulting infusion ranged from 209 to 307 ppb. The infusion had a strong, disagreeable odor varying from musty to pigpen in nature. No medicinal or phenolic odors were noted at any time. The tannin in the oak leaves is thought to be the phenol precursor.

Other studies concerned the reaction between pure phenol and chlorine. It was found that when stoichiometrical amounts of chlorine were added the phenol was destroyed completely. With a lesser amount of chlorine chlorophenols were formed.

The author reported that phenolic compound concentrations have been found in the Ohio River up to 200 ppb and are being handled routinely by water treatment plants without chlorophenol tastes in the finished water. Conversely, medicinal tastes have been reported where the raw water contained no phenol.

In the discussion which followed, it was asked whether leaves other than oak had been used in experimental work. The response was that beech leaves have been used and have produced about the same result. Use of pine leaves resulted in phenoloids of about one-tenth that of deciduous leaves.

Another question referred to the possible effect of the polyethylene bag on the phenolic content of the leaf infusion. The author stated that its effect had not been measured.

Synthetic Detergents in Activated Sludge

A paper entitled "Effect of Synthetic Detergents on Activated Sludge" was presented by R. M. Manganelli of Rutgers University, New Brunswick, N. J. This report covered the results of studies on the effect of one anionic and one cationic synthetic detergent on the character of activated sludge and on the rate of its oxygen uptake as measured by a Warburg respirometer. Nacconol was the anionic and Ceepryn, the cationic syndet used.

The suppressive effect of Nacconol on the oxygen uptake of activated sludge was found to decrease with an increase in the sludge solids concentration. The important parameter governing the rate of oxygen uptake was found to be the syndet to sludge solids ratio.

The effect of Nacconol upon the adsorption of organic colloids was determined by the addition of a known quantity of organic nitrogen to the activated sludge and subsequent measurement of the efficiency of its removal in the presence of increasing concentrations of Nacconol. It was found that 22½ per cent of the organic nitrogen was removed when no Nacconol was present, 14 percent with 50 ppm Nacconol and zero removal at 100 ppm Nacconol. When activated sludge was pretreated with Nacconol, there was no removal of organic nitrogen. This supported the author's conclusion that Nacconol has a definite inhibitory effect on the adsorption phenomenon.

Programmers

K. S. Watson R. D. Hook

Studies were made on the removal of Nacconol by activated sludge and it was found that the efficiency of removal varied from 25 per cent on the first pass to 2.6 per cent on the third pass through the sludge. This observation indicated that the adsorption of Nacconol would reduce the adsorptive capacity of the sludge for sewage colloids.

The effect of Nacconol on the oxidizing capacity of activated sludge was measured by its effect on specific groups of bacteria and on the appearance of the microbiota in the sludge.

In the presence of Nacconol it was found that the nitrate formers were destroyed first, followed by the nitrite and then the ammonia formers. The stalked protozoa showed a marked deterioration with a separation of the flowering portion from the stalk. No free swimming protozoa were found and the activated sludge had the appearance of a stabilized sludge. With Ceepryn the quality of the sludge was even worse. The conclusion reached was that non-oxidizable syndets have a dissociating effect upon activated sludge.

In the discussion which followed it was pointed out that the results should apply only to the chemical structure of Nacconol rather than to alkyl aryl sulfonates as a group. At Mass. Inst. Tech., experimenters have obtained up to 70 per cent removal of a pure alkyl benzene sulfonate with no interference with sewage oxidation where a well acclimated sludge was used.

There were differences of opinion among discussion participants as to whether the adverse effect of 100 ppm Nacconol on activated sludge could be translated to 10 ppm syndet concentration in sewage. The author emphasized that he was reporting the results of laboratory studies and that they may or may not be fully applicable under field conditions.

COD of Syndets

A paper entitled "COD Values of Syndets, Surfactants and Builders" was presented by W. D. Sheets and G. Malaney of Ohio State University, Columbus, Ohio.

Studies were conducted to determine the correlation between the dichromate chemical oxygen demand and biochemical oxygen demand tests using Ohio River water, syndets, surfactants and builder compounds. The results showed no consistent relationship between the two tests which would allow the prediction of the BOD of the Ohio River water from the COD.

The study of the synthetic detergent compounds illustrated the different parameters measured by the two tests through use of one readily oxidizable surfactant, others highly resistant to degradation, and organic and inorganic builder compounds. The difference in magnitude between the BOD and COD tests increased with greater resistance to biochemical oxidation. These results serve to emphasize the fact that the COD test cannot distinguish between biologically stable and unstable compounds.

The authors stated that the analytical results support the view that certain of the component compounds of syndets contribute to the variance between COD and BOD results of sewage and river water containing syndets.

The discussion which followed the presentation of this paper disclosed that non-acclimated seed was used for the BOD tests of the surfactants and organic builders. Participants in the discussion agreed that a constant correlation between COD and BOD

can only be obtained where the character of the waste remains constant.

Industrial Waste Disposal via Chicago Sewers

A progress report of "THE INDUSTRIAL WASTE PROBLEM OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO," prepared by E. Hurwitz and M. R. Jones of the Sanitary District staff, was presented by by the senior author.

State enabling legislation authorizes the Sanitary District to exert control over all industrial waste discharges in excess of 10,000 gpd.

Industrial waste investigations by the District started in 1912 with a lengthy study of the packing house wastes of the Chicago stock yard area. By the end of 1955, a total of 738 investigations involving 573 different establishments had been completed. A total industrial waste flow of over 138 mgd. is discharged to District sewers. This waste has a total BOD population equivalent in excess of 3 million.

In December, 1949, a comprehensive industrial waste ordinance was submitted to the District for study. This would have given the chief engineer the authority to control wastes discharged within the District, establish a price structure for waste disposal based upon volume, BOD and suspended solids, and would have authorized establishment of rules and regulations requiring proper records and sampling. Action on this ordinance has been postponed indefinitely.

Synthetic detergents were reported to be responsible for an increase in the phosphate content of processed sludge. No severe problems have been encountered from foaming. Another effect of the changing times has been the large amount of ferric chloride encountered in wastes discharged by the new printed circuit industry.

The discussion of this report disclosed that the presence of inflammables in Chicago sewage is not a problem because of the tremendous dilution factor.

Other questions elicited the information that there is no need to control the quality of industrial wastes discharged to Chicago's sewers because of the dilution and extensive treatment provided by the District. The District accepts all wastes from meat packers. Present practice at the packing houses calls for the removal of paunch manure and blood.

The goal of the Sanitary District is to connect all industrial waste outfalls to its sewers and to eliminate private outfalls along the smaller streams.

Sewage Lagoons

The current status of waste stabilization ponds for the treatment of raw sewage in the states of the Missouri River Basin was reviewed in a paper titled "RAW SEWAGE LAGOONS IN THE MISSOURI BASIN" by Glenn J. Hopkins, U.S. Public Health Service, Kansas City, Mo.

The use of oxidation ponds for waste treatment in the United States began in 1928. Until recently, however, their use was restricted primarily to providing secondary treatment, and the use of stabilization ponds as a sole means of treatment for raw sewage did not receive favorable consideration from engineers. Today, their use as sewage treatment

More Programmers

R. C. Merz W. D. Sheets

devices in certain locations is viewed favorably. The number of communities within the Missouri Basin using this method of treatment now exceeds 100.

The processes involved in treating raw sewage under conditions existing in the northern states have not been well understood. In 1954, the Public Health Service was requested by various state water pollution control agencies and the Conference of State and Territorial Health Officers to undertake a cooperative study of waste stabilization ponds.

Though very few design data are yet available, certain elements of good design have been established. Adequate distribution of the influent raw sewage can best be attained through use of a center inlet. Satisfactory operation can be obtained with pond depths as great as 7 to 8 feet. A relatively non-porous soil is desirable, since the pond bottoms may have to be sealed to prevent contamination of ground water. Bottom loss because of sludge deposits does not have to be considered. Design criteria in the Dakotas calls for 4 acre-feet per 100 population or equivalent.

Single chamber lagoons can provide an effluent commensurate with that of a well operated secondary treatment plant. During cold weather, however, the effluent quality may decline to the level of a primary effluent. Lagoons in series afford a higher degree of stabilization.

Outstanding reduction in coliform densities have been obtained. Suspended solids are greatly reduced in the winter, but may actually increase in the summer because of algal activity.

Maintenance problems include animal damage, undesirable aquatic growths and need for protective dikes. Overflow lagoons will produce a poorer effluent during the period of ice coverage. At southerly latitudes anaerobic conditions will be less frequent.

Lagoons aparently fill a long felt need and will probably play a large part in the nation's water pollution control program. Their use by larger communities remains largely unexplored.

The discussion of this paper established that no odor nuisances have been produced from ponds more at 100 persons per acre. Odors have been produced from ponds more heavily loaded, following loss of the ice cover. Other questions brought answers that in the Missour Basin evaporation from lagoons has exceeded the rainfall, no mosquito or fly problems have been experienced, and that no problems have arisen from the contamination of wildlife.

Biological Systems in Organic Waste Treatment

In a paper on "USE OF BIOLOGICAL SYSTEMS IN THE TREATMENT OF ORGANIC INDUSTRIAL WASTES" Ross E. McKinney, of the Massachusetts Institute of Technology, discussed the basic principles of the biological treatment of organic industrial wastes and the four major types of processes in use today. These were given as anaerobic digestion, oxidation ponds, trickling filters, and activated sludge.

The anaerobic digestion process was described as a relatively new development. Recent investigations have shown that it is possible to obtain efficiencies equal to aerobic biological processes for wastes containing not less than 0.1 per cent organic solids. Efficiencies of 75-90 per cent are obtainable at loadings up to 100 lb. volatile solids per 1000 cu ft of tank volume. The major problem is that of keeping a proper balance between the acid forming and methane forming groups of bacteria. Conditions necessary for maximum efficiency include:

1. Constant inflow of raw waste so

to eliminate feed and starve cycles.

2. pH adjustment between 6.5 to 8.5. If wastes contain a high concentration of carbohydrates and have insufficient buffering capacity constant neutralization of excess acids must be provided for.
3. Proper temperature must be maintained.
4. Constant mixing is necessary to keep the bacteria in contact with their food supply.
5. Supplemental nitrogen and phosphorus should be provided if needed.
6. Digested sludge must be recirculated so as to maintain the bacterial population by reseeding.

Oxidation ponds require a considerable land area and an abundance of sunshine. They are best operated at low organic loadings. Bacteria populations oxidize the organic wastes to the end products of water, carbon dioxide, ammonia and ortho-phosphate. Their oxygen is provided through photosynthesis by the algae. Other microorganisms are present for the purpose of controlling the bacterial and algal populations.

The trickling filter system is probably the most widely used and most suitable for the removal of colloidal organic material. It is a facultative device, being partially aerobic and anaerobic. In loadings of less than 95 lb of BOD per 1000 cu ft of filter stone efficiencies as high as 85 per cent are obtainable. Considerable research is now being carried on with new media designed to eliminate the problem of ponding. The Dow Chemical Co. has reported an efficiency of 98 per cent on plastic media at a loading of 100 lb of BOD per 1000 cu ft. An efficiency of 93 per cent at 200 lb BOD per 1000 cu ft using tile as a filter media has been obtained at M.I.T. Trickling filters using such new media operate more as mechanical aerators than true trickling filters and the microorganisms present closely resemble activated sludge microorganisms.

And, More Programs:
E. Hurwitz R. E. McKinney

The greatest problem encountered in use of a conventional activated sludge system is the tremendous demand for dissolved oxygen at the point of solids return in the aerator. The reason for this is the presence of a heavy load of adsorbed organic matter and a near-oxygen starvation. Because of the resulting anaerobic condition at this point, certain modifications of the activated sludge process have been made. These are:

1. Variations of standard activated sludge process
   a. Tapered aeration
   b. Step aeration
   c. Kraus Process
   Efficiencies of 95-98 per cent are obtainable.
2. High rate activated sludge-efficiency up to 75 per cent.
3. Dispersed aeration
   In this process the bacteria are kept in the log growth phase. Accordingly, efficiencies of only 30-50 per cent can be obtained.
4. Biosorption
   This is the only activated sludge process designed primarily for colloidal organic matter. Much smaller aeration tanks are used.

Problems encountered in the design of an activated sludge system were summarized as follows:

1. Variable organic concentration
2. High initial oxygen demand
3. pH adjustment
4. Supplemental nutrients
5. Excess sludge
6. Feed-starvation cycle
7. Complex operation and control

The author reported that each of these problems can be eliminated by using a system which is operated in endogenous metabolism at a solids level of 10,000 to 20,000 ppm. The carbon dioxide produced neutralizes wastes with a pH as high as 11.5 forming a buffering capacity for acid wastes which may enter the system. Oxygen transfer was said not to be a problem in a system of this kind.

Design factors to be considered in the design of a biological system are the nature, concentration and volume of the waste to be treated, variation in flow, and capital and operating costs.

The operator of a waste treatment plant (either industrial or domestic) utilizing a biological system must understand what microorganisms are present, why they are there and what they are trying to do.

The discussion which followed this paper disclosed that the author has recently designed a plant utilizing endogenous metabolism. Several other similar plants have been placed in operation throughout the country according to discussion participants.

E. J. Laubusch Joins Staff of Chlorine Ins't.

Edmund J. Laubusch, sanitary engineer with the U.S. Public Health Service, has joined the staff of the Chlorine Institute, Inc., of New York City as research engineer.

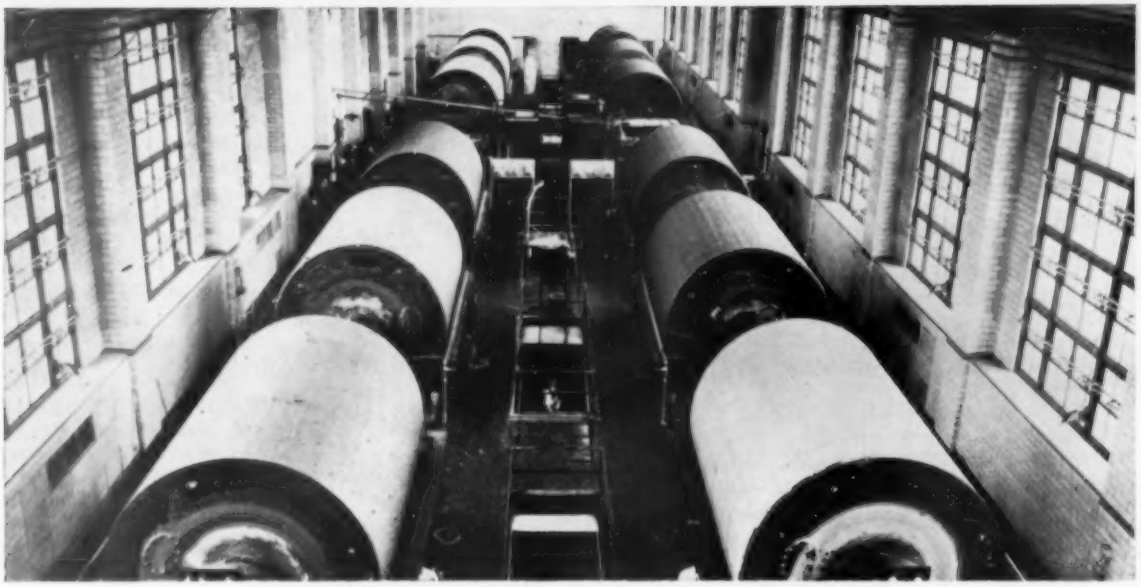
A native of Irvington, N.J., Mr. Laubusch obtained the B.S. degree in civil engineering at the Newark College of Engineering in 1949 and the M.S. degree in sanitary engineering from the Massachusetts Institute of Technology in 1951.

Mr. Laubusch carried out research on the development of the membrane filter technique and its application to the bacteriological examination of water at the Robert A. Taft Sanitary Engineering Center in Cincinnati. Since June 1954 Mr. Laubusch has worked at Washington headquarters of the Public Health Service, with the Office of Engineering Resources. Mr. Laubusch is the author of several published technical papers on the membrane filter technique and other sanitary engineering subjects. He is a member of the American Public Health Association, the Federation of Sewage and Industrial Wastes Associtaions and the American Water Works Association.

Shaw Cole Heads AWWA Publication Committee

E. Shaw Cole has been appointed Chairman of the Publications Committee of the Am. Water Works Assn. He succeeds Richard Hazen who has served as chairman of the committee for several years and asked to be relieved.

Mr. Cole is Chief Engineer and Vice President of The Pitometer Associates, New York. Mr. Hazen is the senior partner of Hazen & Sawyer, Consulting Engineers, New York.



VACUUM-FILTERS (8 original + 4 new) Detroit's Sewage Treatment Plant

Plant Design for Future Expansion Pays off at Detroit

How the design of a 16 year old sewage treatment plant has reduced expansion problems at important dollar savings

by GEORGE D. DICKEY
Chicago Bridge & Iron Co.,
Conkey Equipment Div.,
New York, N. Y.

WHEN the Detroit sewage-treatment plant went into operation it incorporated certain ideas that attracted but little attention at that time. Now, in 1956, the farsightedness of the Detroit city engineers who designed the plant has permitted its expansion, 16 years later, with a minimum of fuss and fretting. They designed into the plant the means to expand it with least trouble and at minimum expense.

The plant, opened in 1940, was designed with excess capacity—enough to handle an expected population of 2,400,000 by 1950. Ideas also were incorporated into the design to permit ready expansion to accommodate a 4-million population. At that time, the sewage load was 400 mgd containing 200 tons of solid matter. Now it is 500 mgd containing 300 tons of solids.

New Pumps, Bar Screens and Grit Collectors

Expansion provisions were made at various points in the plant layout. The original pumping station, to which sewage first goes from the interceptors, had six vertical sewage pumps with a total capacity of 890-mgd. Two new pumps, now being installed, will add 300 mgd more capacity. The original design specified that areas be left open for the new pumps.

Likewise, extra space was provided at the next sewage processing point—in the screening and grit building for the two new bar-rack screws and the two pairs of new grit collectors now going into place alongside the six older bar racks and the six pairs of older grit collectors. The bar racks are mechanically cleaned units with ¾-in. openings between parallel bars. Grit, consisting of sand, gravel, and other heavy materials, settles out in the 150-ft-long grit channels. Each pump has its individual bar screen and grit chamber.

Additional Settling Tanks

Sewage then goes to the sedimentation tanks, which also are being expanded in capacity. To the original eight tanks are being added two new ones of the same design but shallower in depth. These tanks are unusual in that they are covered. Rectangular in shape, each contains seven channels 16 ft wide and 272 ft long. The design engineers provided space for these two new tanks plus two more tanks to be added sometime in the future. The installation work now underway is adding facilities to make the addition of the final two tanks easier when they are needed.

About 20% of the sludge from the sedimentation tanks goes to a heated digester, from which gas is piped to a 24,500-cu ft Hortonsphere pressure type gas holder supplied by Chicago Bridge & Iron Co. The gas then goes to the boiler house for use as fuel. The sludge from the digester, along with the 80% of undigested sludge, is pumped to the sludge filter house.

Four New Sludge Filters

It is here that the designing engineers' forethought paved a smooth way to plant expansion in the important step of sludge dewatering. Eight Conkey rotary-drum vacuum sludge filters, of 500-sq ft filter area each, were installed in 1940, and was provided for additional filters. Four more Conkey filters were installed in

his space late last year. Even the pipe lines were arranged in the original layout so they could be extended readily to tie in the new filters.

The new Conkey filters, a product of Chicago Bridge & Iron Co., were made the same size as the original filters, 11½ ft in diameter and 14 ft long, so they would fit the floor space provided for them in the original layout. To reduce maintenance expense the design of the new units was kept similar to that of the older units.

The new filters have one distinctive feature not at the time available in the older ones. A water spray has been incorporated to clean the filter cloth in the dead, or no-vacuum, area without interruption of drum rotation. As a rule, the filters operate 24 hours a day, 7 days a week, with time out only to change filter cloths and for routine maintenance. Cloths on the older units are changed about every 350 hr., but this time may be lengthened for the new filters with their continuous washing feature and corrosion proof polystyrene backing grids. On the older filters, it is sometimes necessary to wash filter cloths once each shift, which requires about 30 minutes of downtime.

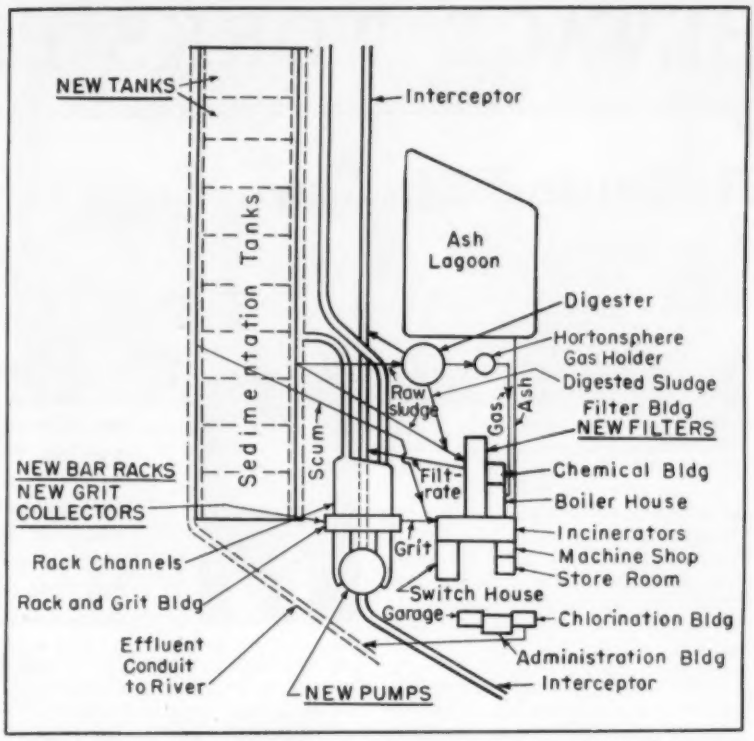
Since the sewage-treatment plant opened, filter operation has been relatively trouble-free. The sludge is conditioned with ferric chloride and lime before filtration. The sludge cake is fed to the four multi-hearth incinerators.

According to F. H. Burley, Engineer of Sewage Treatment, high filtration rates have been maintained with a nominal amount of chemicals. Typical dosage figures are 0.95% ferric chloride and 8.79% lime, the latter added in the form of cheap waste carbide lime from a nearby source, rather than the more expensive pebble lime. To save ferric chloride, filters are sometimes operated with lime only when the sludge is easy to filter. This condition results from greater storm flows. (Detroit has a combined sewerage system; all storm water, as well as domestic and industrial wastes, drains into the sewers.) Thus, during rainy weather, a 12% solid sludge can be dewatered with lime only (over 9%), primarily because of the sand and silt brought in by the storm water.

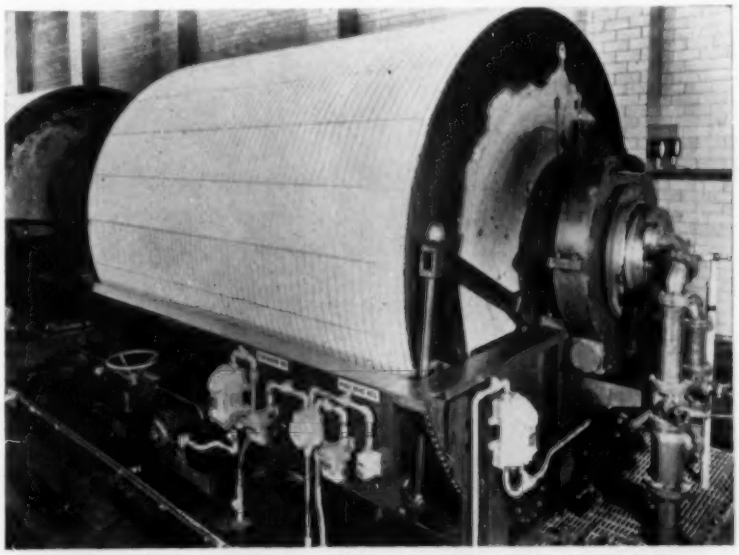
Original Incinerators Ample

The high efficiency of the Conkey filters, producing a filter cake of 55 to 70% moisture, aids operation of the four multiple-hearth incinerators in which the sludge cake is burned, along with grit from the collectors and scum from the sedimentation tanks. Varying the filter operation produces a sludge cake with the required moisture content for the incinerator. A greasy sludge, for example, generates excessive heat in an incinerator and therefore needs more moisture to reduce the heat and hearth temperatures. Cake moisture varies with the volatile content of the sludge as a rule, averaging 70 to 72% with a high-volatile sludge.

In the incinerator building, space was likewise provided in the original plant layout for future expansion. However, the two additional incinerators for which floor space was planned are not yet needed. The four units can handle present requirements.



FLOW DIAGRAM, Detroit Sewage Treatment Plant; shows paths of sewage, sludge, filtrate etc. and areas of plant expansion.



NEW CONKEY FILTER—one of four, with pressure spray added for continuous filter cloth cleaning.

SEWAGE WORKS PRACTICES

Activated Sludge

Series 2—Part 7

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering, Purdue Univ., Lafayette, Ind. In this series, he discusses *Sewage Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

EDWARDS SAID in 1935[1] that the mechanism of the activated sludge process probably involves physico-chemical, enzymic, biological and bio-chemical reactions and that at some time every one of these phenomena has been used to explain the entire process, but it is generally agreed that each plays a part in the operation and that a combination of all is essential for satisfactory purification.

The Process

Parsons and Wilson[2] believe that the reactions mentioned by Edwards bring about clarification, reactivation of the sludge and nitrification. Even though the process has been divided into stages it is actually very difficult to separate the various reactions because they are all so interrelated.

For many years there have been arguments about whether the activated sludge process is chemical or biological. It is a certainty that biological life is essential for the completion of the process but it is certainly debatable whether the processes preparing food for the microorganisms are chemical or biological.

In the clarification by activated sludge the carbonaceous and nitrogenous organic materials, whether they are in suspension, colloidal or in solution, are removed by coagulation and adsorption. The clarification takes place in a very short period of time. This rapidity of action can be demonstrated by placing about 100 ml of return sludge containing 10,000 ppm. in a 500 ml cylinder, adding 400 ml of sewage to the sludge, inverting the cylinder about ten times and then allowing the sludge to settle. If the activated sludge is in good condition the sewage will be reasonably well clarified. Bender has used the clarifying power of activated sludge to advantage when he has exposed waste activated sludge from the Indianapolis plant to a large quantity of sewage, thereby clarifying the sewage but with no reactivation of the sludge.

In the clarification there is very little if any decomposition of the materials removed from the liquid. It is reasonable to believe that in order to have the clarification process carried on there must be some rejuvenation of the sludge. The rejuvenation or reactivation is believed to be accomplished by the activity of microorganisms.

The biological reactivation is carried on by a mixture of microorganisms. Ruchhoft, Butterfield, McNamee and Wattie[3] have shown that the clarification and reactivation can be carried out with pure cultures of bacteria isolated from good activated sludge. The fundamental characteristic of the organisms isolated and used to demonstrate clarification and reactivation were of the zooglea-forming group. Theriault[4] believes that the reactivation process and the clarification are closely allied and that the gelatinous matrix behaves as a base exchanging substance in the clarification and that it is regenerated by the bacteria that produce it. Hoover, Jasewicz and Porges[5] indicate that in the reactivation of the sludge the stored food is utilized.

In the earlier years of the use of activated sludge, considerable attention was given to nitrification and the appearance of nitrites and nitrates in the effluent. In more recent years less attention has been given to the actual nitrification taking place. It is true that the presence of nitrates in the concentration of 4 to 12 ppm. in the effluent indicates a highly oxidized sludge.

DIFFUSED air aeration tanks

Weston and Eckenfelder[6] have stated that it is theorized that: (a) organic matter is removed from solution by reaction with enzymes that bring about coagulation; (b) organic matter is oxidized; (c) bacteria cells are produced from organic matter removed; and (d) cell material is oxidized.

In the cell material oxidation there is certainly an oxidation of protein materials with the production of nitrites and nitrates. It therefore can be reasonably deduced that the presence of nitrates in an activated sludge plant effluent means that a stabilizing of bacterial cell population is taking place or that all of the nitrogenous materials in the sewage are not being converted into living cell material. Hoover and Porges[7] call the oxidation of bacterial cell material "endogenous respiration" and say that it is analagous to the basal metabolism in humans.

The biochemistry of the activated sludge process is complex and no doubt is not yet thoroughly understood but certain fundamental concepts are well established.

Oxidation Rates

The activated sludge process was developed with the understanding that it utilized aerobic microorganisms to do the work required.

In the wet combustion taking place in the activated sludge process, quantities of carbon dioxide are produced. In fact, carbon dioxide is the main end product of aerobic decomposition.

Heukelekian and Ingols[8] as well as many others have studied the oxidation rate of activated sludge. Some of the workers have measured the carbon dioxide produced and others have measured the amount of oxygen utilized. Heukelekian and Ingols found that the highest rates of carbon dioxide production occur during the initial period of aeration of a sewage with an activated suldge. They showed that the quantity of carbon dioxide produced was in direct proportion to the strength of the sewage being treated by activated suldge.

Kessler and Nichols[9] measured the amount of oxygen used in the oxidation of sewage with activated sludge. This earlier work also showed that there is a higher oxidation rate in the earlier stages of the activated sludge process. They showed that the oxygen requirements at the beginning of an aeration tank are five to six times greater than they are at the end of the aeration tank .

The studies reported by the writer[10] [11] showed that there is considerably more oxygen utilized at the beginning of the aeration in an activated sludge plant.

MECHANICAL aeration tanks—Hartford City, Ind.

Kessler[9] reported that the oxygen requirement at the beginning of an aerator might be as high as 137 ppm per hour and after 2.5 hours of aeration it might be down to a demand of 28 ppm. Other test data presented by him showed that the demand in the earlier stages of aeration might be only 20 ppm per hour, decreasing to 5 ppm per hour after 17+ hours of aeration.

In utilizing mixed liquor solids of 5000 ppm in the apparatus used in the writer's studies[10] the total oxygen requirement was as high as 190 ppm of oxygen per hour at the beginning of aeration. Tests over a long period of time showed that the demand for oxygen after the required aeration period in an aerator should be between 20 and 70 ppm per hour. These data do show the need for sup-

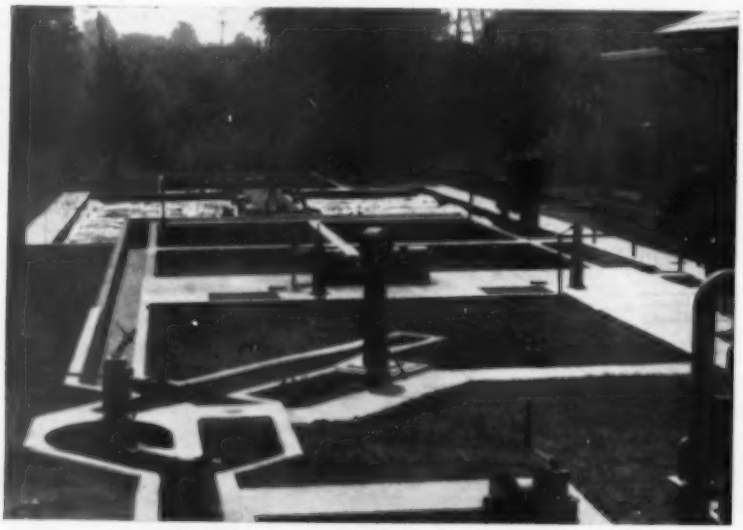
Photo courtesy Dorr-Oliver Corp.

ACTIVATED sludge plant-Canton, Ohio

DIFFUSED air aeration—Hammond, Ind.

plying greater quantities of air at the beginning of an aeration tank. "Tapered aeration" is the term that has been applied where there has been an attempt to apply air at the demand rate in the aeration tank.

The actual demand of activated sludge or oxygen does not give the plant operator a way to determine the amount of air that he should apply to an aerator. He must depend in most cases on the amount of oxygen remaining dissolved in the liquid to guide him in the regulation of the air applied. A general rule applied in some operation standards says that the dissolved oxygen in the liquid at the end of an aerator should not be below 2.5 ppm. This should not be interpreted to mean that this concentration is needed because it has been said that the organisms will get their required oxygen if there is any dissolved oxygen present. It is most difficult with the high oxygen requirement at the beginning of an aerator to make a dissolved oxygen determination on the liquid at that point, therefore it is practical to run the dissolved oxygen on the liquid at the end of the aeration tank where the demand rate is much less. Finding 2.5 ppm of oxygen at the end of the aeration tank means that if this is an appreciable amount of dissolved oxygen at the end of aeration then it is hoped that there will be the amount needed at the beginning of the aerator. Usually the air requirement is 400 to 1000 cubic feet per pound of B.O.D. removed.



ACTIVATED sludge plant—Greencastle, Ind.

Mixed Liquor Solids

The concentration of mixed liquor maintained has varied from plant to plant. In the mechanical aeration units it has usually been found impossible to maintain concentrations of much over 1200 ppm while in the diffused air systems mixed liquor solids as high as 6000 ppm have been maintained.

It has been concluded that there is no one fixed concentration of mixed liquor solids that is universally satisfactory in all plants. Back in the 1930's there was a trend to carry lower concentrations of mixed liquor solids; in recent years the trend has been to carry them above the once fixed figure of 2500 ppm.

Heukelekian[12] has said the higher the concentration of mixed liquor solids, the lower will be the rate of accumulation of solids when treating a particular sewage. This seems reasonable because the higher the mixed liquor solids, the longer will be the retention of solids in the system. The period of retention of solids in the system is sometimes described as sludge age. The age of sludge in a particular plant governs the volatile solids content of the mixed liquor. Usually the higher the ash content of the mixed liquor solids the greater has been the oxidation of the volatile solids.

It is believed that mixed liquor solids with an ash content of 35 to 40 percent can be expected to settle very well. The settling characteristic of a mixed liquor is easily determined by the sludge index test. Sludge index is defined as the volume of settled sludge occupied by one gram of solids after settling 60 minutes. The reciprocal of the sludge index times 1,000,000 will give the concentration of the settled sludge in ppm. It can be said that the return sludge concentration in the plant should never be greater than the concentration as calculated from the sludge index.

It is necessary to keep activated sludge solids well aerated and in order to do this they must not be retained for more than an hour in the settling tank. A check on the balanced condition of the mixed liquor solids and the return sludge solids can be made with the simple formula:

$$(a + b)x = by$$

where a = sewage flow in mgd
b = return sludge flow in mgd
x = mixed liquor solids concentration in ppm
y = return sludge solids concentration in ppm

Substituting values obtained from analyses and meter readings will make it possible to determine whether the solids and flows are in balance. If the equation does not balance then a value for return sludge concentration computed from the sludge index should be substituted in the formula and then it must be solved for return sludge flow. This return sludge flow computed in this manner is the minimum flow that can be utilized to keep the solids in the system in balance.

B.O.D. Loadings

The present day basis of design for aeration tanks built in some parts of the country is that there must be 1000 cubic feet of aeration tank for every 33.3 lb of B.O.D. in the aerator influent. There are some plants in operation today[13] where 2 to 3 times this loading is being successfully handled. It is the writer's opinion that these plants are being skillfully handled and that there is no limit on the quantity of air being used, if it is observed that the air is actually needed. When the high loadings are practiced and exceptionally well purified effluents are obtained the concentration of mixed liquor solids is proportionally higher.

Temperature Effects

Wisely[14] has written that hot weather temperatures do not seriously affect the activated sludge process. The writer has found from his work in the Indianapolis plant[15] that the detention time in an aerator could be reduced from 11 hours at 14° C. to 7.8 hours at 26° C. This also means that a larger quantity of B.O.D. can be oxidized in warmer weather than can be in the months when the sewage is cooler.

Sawyer and Rohlich[16] found that the equation $y = 0.71\ x^{1.54}$, in which y is the relative activity in per cent based on the value of 25° C. taken as 100 per cent and x is the temperature in degrees Centigrade, has been found to apply in general to the influence of temperature on the rate of activated sludge oxidation. The Rohlich equation says that the activity is 45 per cent less at 15° C. than it is at 25° C.

Waste Sludge

The amount of sludge solids that must be wasted each day from a plant depends upon the pounds of volatile mixed liquor solids in the plant and the pounds of B.O.D. received each day. Heukelekian, et al.,[12] have developed the formula:

$$A = -0.055\ S + 0.5\ B$$

in which A = the pounds of volatile solids accumulated per day, S = the pounds of volatile mixed liquor suspended and B = the pounds of B.O.D. fed per day. It is apparent from this equation that the greater the concentration of volatile solids in the mixed liquor the less will be the poundage of volatiles that will have to be wasted, providing the B.O.D. loading remains the same.

SMALL activated sludge plant—Culver, Ind.

Summary

1. Activated sludge functions as a purifying process utilizing clarification, reactivation, and oxidation processes.

2. The demand of mixed liquor solids for oxygen is greater shortly after being fed with sewage.

3. The settling characteristic of mixed liquor determines the amount of return sludge that must be pumped.

4. The B.O.D. loading that a plant can handle depends to a great extent on the amount of air that can be supplied and the concentration of mixed liquor solids.

5. Temperatures of the liquid in the aeration tank can greatly influence the amount of organic matter that can be removed and oxidized in the activated sludge process.

6. The quantity of waste sludge that must be disposed of each day depends upon the mixed liquor concentration and the B.O.D. load going to the aeration tanks.

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On Keeping Operating Records

An open letter from one superintendent to another

Dear Bill:

Like you, we have a smallish water system and not much help to run it with, so we can't spend too much time getting and working up data about its operation. Some fellows with small systems make the big mistake of gathering so much information on it that they bog down with the effort and have to give it up as a bad job, ending up with keeping no records at all. Beyond a certain point, additional details give you only a headache.

With this in mind, I will gladly tell you what records we *do* keep and how we use them. Incidentally, no specially printed forms are needed. These may be nice, but we think are not necessary.

Fancy Record Forms Not Necessary

Both our wells are metered, which, by the way, ought to be common practice instead of being only fairly so. We keep daily readings of these meters on one of those yellow, ruled, legal-size pads, leaving one pad at each well site. We also put down symbols for the state of the weather, R for rain, C for cold, etc., as a matter of information. The last day of each month we record the static and pumping levels in each well and the quantity of water used by the water-lubricated well pump bearings. This is registered by a meter in the bearing-water supply line.

At the end of the month we tear off the sheets and bring them into the office. There the daily totals are combined on a six column columnar sheet: a line for each day, separate columns for each well, and the total daily production. Daily weather symbols are put in the latter column. At the bottom of each column the monthly totals, the static and pumping levels, and the bearing-water used are set down. Figures for two months operations are on one sheet in our case.

A second record, kept in an ordinary notebook, is made of the monthly power consumption there. Power meter readings, kilowatt hours consumed, and the cost, are recorded.

The third record summarizes the billing of customers. It too, is kept on a six column columnar sheet and shows the dollar amount and total gallonage billed, the accounts receivable balance just prior to billing, the number of customers billed, and the number of estimated bills, all separately for each meter route. This data comes from the billing machine tapes.

Consolidated Monthly Records

Because it is convenient to have all this information in one spot for easy reference, here is what we do:

On a wide, eighteen column columnar sheet the three sets of records are summarized. Under appropriate column headings we show monthly totals of:

(1) The number of customers.
(2) The dollar amount billed.
(3) The accounts receivable balance.
(4) The number of estimated bills.
(5) The gallons pumped.
(6) The kilowatt hours consumed.
(7) The cost of power.
(8) The well pump bearing-water used

From these figures we work out the average monthly bill and gallonage per customer; metered water accounted-for (percentage); power cost per customer; and, for each plant, the kilowatt hours per million gallons pumped per foot of head (using the well pumping levels and the average plant discharge pressures); the cost of power per million gallons pumped and per kilowatt hour. Once a year each column is averaged out.

Looking over this summary, we can tell, for instance, that our pumping equipment needs overhauling if the kilowatts per million gallons per foot of head figure starts to go up.

What These Records Show Us

The static and pumping levels give us an idea as to the condition of each well in time to plan rework jobs for the most convenient period, instead of having them come up on an emergency basis.

If the unaccounted-for water percentage goes up, we know something is haywire, somewhere, and get going on finding out the howcome.

If the accounts receivable balance, prior to billing, goes up above an average level, undoubtedly it is because our delinquent bill follow-up procedure has been relaxed; we both know what to do about that.

A consideration of the monthly increase in customer count and the average customer bill helps us in the preparation of our budget estimate by giving us an idea of what the water works income is likely to be in our rapidly growing system.

If the number of estimated bills rises above a certain minimum, we have the crew spend a little more time on meter replacement the next few weeks. If this sounds to you like we have no *regular* program of meter maintenance, you are so right. Remember, ours is just a small system, with a small, busy crew.

Not long after starting this monthly summary we noticed what seemed to be an unnecessarily high power cost per kilowatt hour. Checking, we found that by rearranging the operating periods of our two plants to take the best advantage of the rate schedule provided in our electric service contract, we could save as much as two mills per kilowatt hour. This comes to around seventy-five dollars a month for us and is a saving we now get that we might never have had without records to point out the possibility.

The daily well production sheet shows us at a glance whether we are nearing the maximum safe capacity of the plant in time to at least call it to the attention of the Council, whether they do anything about it or not.

These and other uses of the simple operating records outlined here more than repay us for the small amount of time and effort spent on them. They work fine for us and should do the same for you.

Yours, Hank

CRP*

CATALYTIC
REDUCTION
PROCESS

PERMITS SMALLER TANKS...

through exclusively highest solids loading for sludge digestion

RESULTING IN:

1. Smaller tanks
2. 1/3 to 1/7 of former digester volume for biological requirements of sludge digestion* (Contrasted to actual requirements of former methods of digestion).
3. Non-formation of dense floating solids, termed "scum", eliminating former pro-ration of digester volumes for holding "scum".
4. Consistently highest degree of volatile solids reduction and gas production — through fundamental application of a simple gas diffusion mechanism — with lowest tank volume and simplified piping, without increase in operation supervision requirements.

**Exclusive of sludge storage volume that may be required by subsequent disposal methods.*

Reports Available

Reports describing the PROCESS in detail are available on request. Write to Department F.

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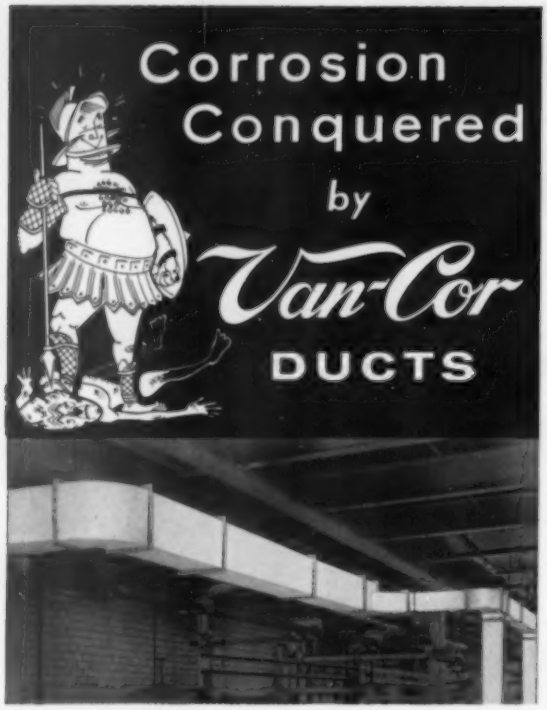
Flush Kleen ®, Scru-Peller ®, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers, Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Barminutor ®, Comminutors.



OLD METHOD—To exhaust fumes from their plating department, a bearing manufacturer used metal coated ducts. Corrosion destroyed them in eight months.

NEW METHOD—Van-Cor Ducts shown above have already served three years—*four times longer*—and are as good as new!

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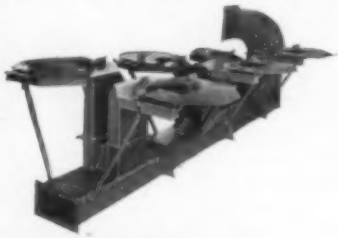

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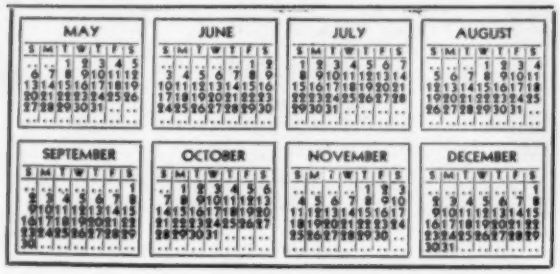

Aug. 8—Kennebunk, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Aug. 27-29—University Park, Pa. (*Pennsylvania State Univ.*)
PENNA. WATER WORKS OPERATOR'S ASSN., Secy., R. Rupert Kountz, Prof. San. Eng., Penna. State Univ., University Park, Pa.

August 29-31—University Park, Pa. (*Pennsylvania State Univ.*)
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, 916 Diamond, Meadville, Pa.

Sept. 9-12—Pittsburgh, Pa. (*Wm. Penn Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, F. J. Van Antwerpen, 25 West 45th St., New York 36, N. Y.

Sept. 12-14—Bolton Landing, Lake George, N. Y. (*Sagamore Inn*)
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 12-14—Clear Lake, Iowa (*P. M. Park*)
IOWA SEWAGE & INDUSTRIAL WASTES ASSN., L. F. Skorczeski, Secy.-Treas. 207 South 15th Avenue, Marshalltown, Iowa.

Sept. 12-14—Kalamazoo, Michigan (*Burdick Hotel*)
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Mich. Dept. of Health, Lansing 4, Mich.

Sept. 12-14—St. Paul, Minn. (*Lowry Hotel*)
NORTH CENTRAL SECTION A.W.W.A., Secy., Leonard N. Thompson, Gen. Manager, Water Dept., St. Paul 2, Minn.

Sept. 16-19—Bretton Woods, N. H. (*Mt. Washington Hotel*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 17-19—Chattanooga, Tenn. (*Hotel Patten*)
KENTUCKY-TENN. SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell Engrs., 533 S. Limestone St., Lexington, Ky.

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KENTUCKY-TENN. INDUSTRIAL WASTES & SEWAGE WORKS ASSN., S. Leary Jones, Secy.-Treas., Cordell Hull Building, Nashville, Tenn.

Sept. 19-21—Atlanta, Georgia (*Georgia Tech.*)
GEORGIA WATER & SEWAGE ASSN., 25th Annual Georgia Water & Sewage School, Georgia Institute of Technology, A. T. Storey, Secy.-Treas., 1210 Hemphill Ave., N. W., Atlanta, Ga.

Sept. 19-21—Toledo, Ohio (*Commodore Perry Hotel*)
OHIO SECTION, A.W.W.A., Secy., M. E. Druly, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio.

Sept. 19-21—Aberdeen, So. Dakota (*The Sherman*)
SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Charles E. Carl, Secy.-Treas., Div. of San. Eng., State Board of Health, Pierre, So. Dak.

Sept. 23-26—Fort Worth, Texas (*Texas Hotel*)
AMERICAN PUBLIC WORKS ASSN., (Public Works Congress), Robert D. Bugher, Asst. Director, 1313 E. 60th St., Chicago 37, Ill.

Sept. 26-28—LaCrosse, Wisconsin (*Stoddard Hotel*)
WISCONSIN SECTION, A.W.W.A. Harry Breimeister, Secy., Chief Utility Engr., City Engineers Office, City Hall, Milwaukee 2, Wis.

Sept. 30-Oct. 1, 2—Jefferson City, Missouri (*Hotel Governor*)
MISSOURI SECTION, A.W.W.A.,
(*Jointly With*)
MISSOURI WATER & SEWAGE CONFERENCE, Warren A. Kramer, Secy.-Treas., Division of Health, Jefferson City, Missouri.

Oct. 2-3—Springfield, Illinois (*Leland Hotel*)
ILLINOIS WATER PLANT OPERATORS' CONFERENCE Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.

Oct. 3-5—Mandan, No. Dakota (*Lewis & Clark Hotel*)
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Jerome H. Svore, Secy.-Treas., % State Dept. of Health, Bismarck, N. Dakota.

Oct. 4-6—Boise, Idaho (*Hotel Boise*)
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSN., W. W. Saxton, Secy.-Treas., 408 Old Capitol Bldg., Olympia.

Oct. 8-11—Los Angeles, Calif. (*Hotel Statler*)
FEDERATION OF SEWAGE AND INDUSTRIAL WASTES ASSNS., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N.W., Washington 16, D. C.

Oct. 10—Caribou, Maine
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Oct. 14-17—Little Rock, Arkansas (*Marion Hotel*)
SOUTHWEST SECTION, A.W.W.A., Secy., Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 15-16—St. John, New Brunswick (*Admiral Beatty Hotel*)
MARITIME BRANCH, CANADIAN SECTION, A.W.W.A., J. D. Kline, Secy.-Treas., Public Service Comm., P.O. Box 608, Halifax, N. S.

Oct. 15-17—Philadelphia, Pa. (*Drake Hotel*)
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Oct. 15-19—Pittsburgh, Pa. (*Wm. Penn Hotel*)
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th St., New York 18, N. Y.

Oct. 18-20—Atlantic City, N. J. (*Hotel Madison*)
NEW JERSEY SECTION, A.W.W.A., Secy., C. B. Tygert, Box 178, Newark 1, N. J.

Oct. 21-24—Mobile, Alabama (*BattleHouse*)
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(*Continued on page 90A*)

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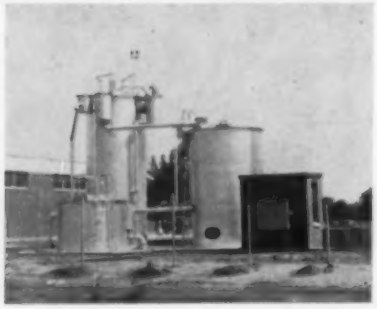
Waste Treatment Plant



The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

Write for New
Spiragester Bulletin No. 135

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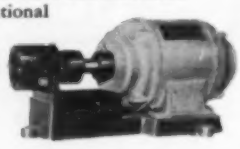

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CALIFORNIA SECTION, A.W.W.A., H. J. Ongerth, Secy.-Treas., 2151 Berkeley Way, Berkeley, Calif.

Oct. 23-26—San Antonio, Texas (*Gunter Hotel*)
NATIONAL ASSOCIATION OF CORROSION ENGINEERS, SOUTH CENTRAL REGION, A. B. Campbell, Exec. Secy., 1061 M & M Bldg., Houston 2, Texas.

Oct. 24-26—Des Moines, Iowa (*Hotel Fort Des Moines*)
IOWA SECTION, A.W.W.A., Secy., J. J. Hail, Supt. of Water, City Hall, Dubuque, Iowa.

Oct. 24-26—Baltimore, Maryland (*Sheraton Belvedere*)
CHESAPEAKE SECTION, A.W.W.A., Secy., Carl J. Lauter, 6955 33rd Street, Washington 15, D. C.

Oct. 29-31—Windsor, Ontario (*Prince Edward Hotel*)
THE CANADIAN INSTITUTE ON SEWAGE & SANITATION, A. E. Berry, Secy.-Treas., Ontario Dept. of Health, Parliament Bldg., Toronto, Canada.

Oct. 31-Nov. 1-2—Bluefield, W. V. (*West Virginia Hotel*)
WEST VIRGINIA SECTION, A.W.W.A., Secy., Hugh W. Hetzer, Engr., W. Va., Water Service Co., Charleston, W. Va.
(*Jointly With*)
WEST VA. SEWAGE & IND. WASTES ASSN., G. O. Fortney, Secy.-Treas., State Health Dept., Charleston 5, W. Va.

Nov. 1-2—Omaha, Nebraska (*Castle Hotel*)
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSN., V. J. Lechtenberg, Secy.-Treas., 614 Standard Oil Bldg., Omaha, Neb.

Nov. 7-9—Old Point Comfort, Virginia (*Chamberlin Hotel*)
VIRGINIA SECTION, A.W.W.A., Secy., J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 8—Greenfield, Mass. (*Hotel Weldon*)
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSN., Henry F. Munroe, Secy.-Treas., 75 Paine Ave., Cranston 10, R. I.

Nov. 11-14—Daytona Beach, Fla. (*Daytona Plaza Hotel*)
FLORIDA SECTION, A.W.W.A., Secy. Jay D. Roth, City Hall, Miami Beach 39, Fla.
(*Jointly With*)
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSN., M. E. Dawkins, Secy.-Treas., % Reynolds, Smith & Hills, P.O. Box 4817, Jacksonville 1, Fla.

Nov. 12-14—Charlotte, N. C. (*Hotel Charlotte*)
NORTH CAROLINA SECTION, A.W.W.A.,
(*Jointly With*)
NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN., W. E. Long, Jr., Secy.-Treas., Box 2091, Raleigh, N. C.

Nov. 12-16—Atlantic City, N. J. (*Convention Hall*)
AMERICAN PUBLIC HEALTH ASSN., Secy., Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. 15-16—Detroit, Michigan (*Hotel Statler*)
NATIONAL ASSOCIATION OF CORROSION ENGINEERS, NORTH CENTRAL REGION, A. B. Campbell, Exec. Secy., 1061 M & M Bldg., Houston 2, Texas.

Nov. 26-28—Colorado Springs, Colo. (*Broadmoor Hotel*)
ROCKY MOUNTAIN SECTION, A.W.W.A., Jack W. Davis, Secy., Johns-Manville Sales Inc., Denver, Colorado.

Dec. 9-12—Boston Mass, (*Statler Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS Annual Meeting. F. J. Van Antwerpen, 25 W. 45th Street, New York 36, N. Y.

Dec. 12—Pittsfield, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Snug right-of-way just routine condition for compact maneuverable Cleveland®

Dodging utility poles, trees and other obstructions, the compact, husky Cleveland "110" cuts utility trenches efficiently in narrow clearances like this. Its full-crawler mounting and low ground bearing pressure are real public relations assets because they minimize damage to lawns, sidewalks and driveways . . . permit efficient digging in soft muddy ground and rugged terrain too. Fast, safe trailer portability, coupled with full-crawler on-the-job maneuverability and a wider range of usable digging speed combinations make Clevelands fast *to* the job and fast *on* the job. You dig more trench . . . in more places . . . at less cost . . . with dependable Clevelands, first choice for utilities trenching for more than 30 years. Talk it over with your local distributor.

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OVERFLOW FROM THE MAIN SECTION

Fluoridation Upheld by Another Appellate Court

A taxpayer suit against the City of Cleveland, Ohio, charging that water fluoridation comprised mass medication and therefore is unconstitutional, went against the plaintiff. The taxpayer took the case to the Ohio State Court of Appeals, but has again lost.

After reviewing the Cleveland case, and several others of similar nature in the country at large, the Ohio Appellate Court concluded that dental caries falls in the category of a disease and constitutes a public-health problem. Therefore, water fluoridation to eliminate or minimize dental caries becomes a legitimate police-power of a municipality and is a constitutional act, as much as is water chlorination or compulsory vaccination.

The Ohio Court states that fluoride treatment of the drinking water supplied a community has not been shown to be a practice of medicine, adulteration, or an infringement of the constitutional liberties of the citizens of a municipality employing fluoride treatment as a public-health measure.

Interestingly, the Ohio Court placed some emphasis on its concurrence with the viewpoint of the Oklahoma Court in the Tulsa case, wherein the Court concluded that the enrichment of water with fluoride no more comprises a "practice of medicine" than it could be considered a practice of medicine when a mother adds calcium in some form to an infant's diet to aid the bone structure and prevent rickets; or, when a mother adds vitamins to her child's diet to prevent diseases caused by diet deficiencies.

ALGAE-FREE WATER MEANS

Copper Sulphate treated water

Not only is Triangle Brand Copper Sulphate successful in controlling algae but it also is effective in killing some aquatic weeds. Since the weeds are submerged and disintegrated, there is no chance of them floating down stream to start new infestations, or to clog the waterway.

In sewage systems, Triangle Brand Copper Sulphate prevents roots and fungus from clogging pipes. However, there is no danger of affecting the surface trees owing to the low concentration of copper sulphate necessary to be valuable.

The new booklets "The Use of Copper Sulphate in The Control of Microscopic Organisms" and "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains" will keep you up to date. Send for a copy today! *Phelps Dodge Refining Corp., 300 Park Ave., New York 22, N. Y. • 5310 W. 66th St., Chicago 38, Ill.*

PHELPS DODGE REFINING CORP.

PHELPS DODGE REFINING CORPORATION NICHOLS HEADING CHEMICALS NEW YORK N.Y.

Frank Brainard, "Back in the Saddle Again."

Frank S. Brainard of Hartford, Conn., inventor of the "Meter Master" tells us that after a few years of retirement he finds this sort of thing may be alright for some, but not for him. He is getting back into production and marketing of an improved "Meter Master", which has been dubbed by water works men—"The G-Man of the water works industry". Announcement of Brainard's improved "Meter Master" appeared on page 92-A of our June issue.

Frank Brainard retired in 1954, as Distribution Engineer for the Water Bureau of the Hartford, Conn. Metropolitan District, after 47 years of service with the Water Bureau and its predecessor Water Commission. He saw water consumption on the system grow from 6½ to 76 mgd. At a farewell testimonial dinner 80 guests did honor to Frank. The Water Bureau made presentations comprising, amongst other things, "Free Water for Life". And, it was all legal too, because this "free water" inscription appeared on a nice shiny water pail, stating that the recipient could

with the pail pack free-water for life from the Reservoir No. 1.

Water and Sewage Works in past years has published a number of articles by leading water works managers and superintendents, enthusiastically telling of the worth of Brainard's "Meter Master" to the water utility. We think we are right in saying that the "Meter Master" received more unsolicited free publicity (spoken at meetings and published in magazines) than any single item in the water supply field.

We wish Frank Brainard, President of the new F. S. Brainard Co., Hartford, Conn., every wish for deserved success and years more of zestful living.

Tom Cole is Dead,

A Pioneer in Water Purification

Thomas A. Cole, for many years Superintendent of Water Purification at Poughkeepsie, N.Y. passed away at his home in Poughkeepsie on May 28th. He was 72 years old.

Up to retirement, six years ago, Tom Cole had been in the city's employ for 35 years as chemist and bacteriologist. Adding 9 years of service with the Auburn, N.Y. water works, makes a total of 44 years experience in water supply and water purification. In 1950 he retired and established his own laboratory in Poughkeepsie.

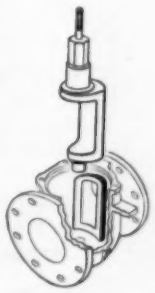
Tom Cole was an enthusiastic member of the American Water Works Ass'n. and had served on the Committee on Standard Methods of Water Analysis. It is believed that under his supervision Poughkeepsie was the second city to employ chlorination of its water supply. If not the second, Poughkeepsie was amongst the earliest to chlorinate the public water supply with chlorinated lime, before the days of liquid chlorine.

Cole was an ardent Royal Arch Mason and member of St. Paul's Episcopal Church. He was as friendly as he was a capable water works man, always ready to help any who might have problems in water purification. He had many bosses during his professional career and none had but good to say of Tom Cole.

ON ALL LINES FROM HEAVY SLUDGE TO GAS, DeZURIK VALVES PERFORM WITH EQUAL EXCELLENCE. THEY OPEN OR CLOSE WITH AN E-A-S-Y QUARTER-TURN . . . . THEY NEED NO LUBRICATION . . . AND THEY DON'T LEAK!

Note the short operating levers on these 8" DeZurik Valves! DeZurik's exclusive eccentric principle accounts for this easy operation. The resilient plug-face contacts the seat only when the valve is closed, and it seals dead tight on any line despite solids in the flow. In opening the valve, the plug swings away from the seat so that the first fractional movement of the plug effectively eliminates all friction between the plug and the valve body—without binding or sticking, without lubrication!

DeZurik Valves are manufactured in a full range of sizes for operation on gas lines, sludge pump discharge, raw or digested sludges, raw sewage and many others.



Write for complete details. Representatives in all principal cities.

DeZURIK SHOWER CO.
Sartell, Minn.

Carl Johnston Joins Staff of Pomeroy & Associates

Carl B. Johnston has joined the staff of Pomeroy and Associates, Consulting Civil and Chemical Engineers, Pasadena, Calif.

Prior to this move Mr. Johnston was staff engineer for the Los Angeles Regional Water Pollution Control Board. Previous employment included Taylor and Taylor, Consulting Engineers, Los Angeles, and Wallace and Tiernan Co., Newark, N. J.

With Pomeroy and Associates, Mr. Johnston will deal with industrial water pollution control problems and design of facilities for the treatment of sewage and industrial waste, and refuse disposal.

Wrought Iron Repeats at Columbus Sewage Plant

Wrought Iron's record of a 21-year resistance to corrosive atmosphere of a sewage treatment plant was a strong influence in again selecting that metal for use in the recently-completed $2,250,000 addition at the Columbus, Ohio, Sewage Treatment Plant.

When the earlier plant was constructed in 1935, wrought iron was used for all pipe services two inches and under. Ninety percent of the 15 tons of wrought iron pipe employed in the 1956 addition is being used for guard railings. The remainder is used for gas lines, miscellaneous piping, and air diffuser piping.

Railings at the new plant addition were installed by Columbus Metalcrafts and the project was engineered by Paul A. Uhlmann and Associates of Columbus.

Kunigk Retires, Successor is Julius A. Kuehl

Walter A. Kunigk, 76, has recently retired as Water Superintendent at Tacoma, Wash., after 45 years of service. Mr. Kunigk came to America from Germany. He became a member of A.S.C.E. in 1923. and of A.W.W.A. in 1924. He has served as Director of A.W.W.A. and was voted the Geo. F. Fuller Award in 1938.

Mr. Kunigk's successor is Julius A. Kuehl who was Assistant Chief Engr. of the Tacoma Water Division, which he joined in 1919. Mr. Kuehl is a member of the A.S.C.E. and A.W.W.A.

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CONTROLS "Flexible" BUCKET TRAVEL!
* It's Patented

1. Anyone who can "open a manhole" can *safely* operate this Flexible Booster Clutch.
2. Eliminates multiplicity of shafts, sprockets, chain, clutches and gear transmission found on all other make machines.
3. No maintenance other than replacing non-stretch belts--which are guaranteed 2 years.

AVAILABLE ON 8, 13 AND 25 H. P. MODELS

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Get Facts Now--Don't Be Sorry Later!

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

W&SW

New Equipment

Earth Drill Doubles As Gate Valve Operator

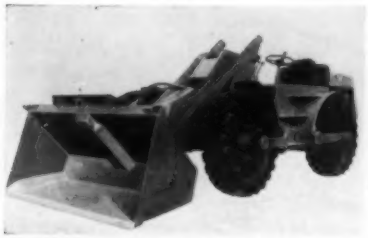
801

The McCulloch Motors Corp., Los Angeles, Calif., has announced that the McCulloch earth drill is now being used extensively for opening gate and other gear-driven valves.

The company cites the case of Kansas City, where the water department is using the drill for opening and closing the large water main valves. As some of these valves are 48 inches diameter, ten feet high and must be turned 400 times to open or close, the job formerly took a crew of 4 to 7 men a full hour to open the valve. Today, two men do the same job in 5 minutes or less by using the earth drill. The drill is powerful but lightweight, will drill at any angle and can be maneuvered easily in close quarters.

New Features Added To Scoopmobile

802



Mixermobile Manufacturers, Inc., Portland, Ore., has now incorporated four-wheel steering, two axle oscillation and unimpaired operator visibility on the new model LD5T Scoopmobile.

This model Scoopmobile is a 1 cubic yard, 5000 lb. capacity front end loader, and will transport a full load with the bucket raised off the ground merely enough to clear the terrain. This gives the operator the same high degree of visibility while underway with a load that he has while loading.

Four-wheel steering affords the operator the ability to get around better in tight spots and rough terrain. Two-wheel oscillation permits one wheel to drop into a hole in rough terrain without loss of tractive power to that wheel.

(Continued on page 98A)

A grain elevator gets a good going over, *INSIDE, OUTSIDE!*

COMPLETE BREAK-THROUGH IN WALL

How to save this costly structure, without rebuilding sections, presented a serious problem.

Workmen on scaffolds, from inside and outside, cut out deteriorated concrete.

Necessity of costly forming was eliminated by the use of THORITE 20-minute set, nonshrink, filling and patching mortar.

THORITE

THORITE permits completion of job in one fall of scaffold, followed immediately by THOROSEAL seal coat.

Air hammers cut away loose and crumbling concrete. THORITE formed into cleaned-out sections, with a minimum labor cost, restored elevators to original condition.

Job completed with the application of THOROSEAL over entire structure.

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• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Absolute Pressure Transmitter

803

The Bristol Company, Waterbury, Conn., has developed a new absolute pressure transmitter, which will measure pressures in ranges as low as 0 to 5 mm Mercury Absolute, and transmit the measurement as a 3-15 psi pneumatic signal to an automatic controller or receiver.

The Metagraphic Absolute Pressure Transmitter is offered to handle pressure ranges from 0-5 mm Hg to 0-760 mm Hg. It transmits a universal 3-15 psi pneumatic signal, and can be used with any standard pneumatic receiver or automatic controller.

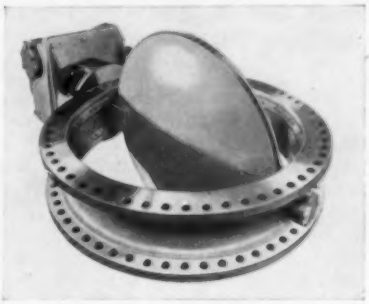
New Series of A-C Standard Butterfly Valves

804

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has developed a new series of butterfly valves designed primarily for municipal water supply or disposal systems.

Suitable for various installations of moderate pressure and pipeline velocity, the new valves meet the recently published American Water Works Association's tentative standard specifications for rubber and metal seated butterfly valves, AWWA C504-55T and C505-55T.

The AWWA specifications classify these valves into groups with respect to maximum service pressure, and



these groups are subdivided with respect to maximum pipeline velocity. Allis-Chalmers valves are now classified in these same ratings. Diameters range from 16 to 84 inches in AWWA sizes. Valves with rubber seats in the housing are made for 25 psi and 50 psi ratings. Valves with a rubber seal ring in the disc are made for all pressure ratings. Metal seated valves are made for 25 psi rating and above.

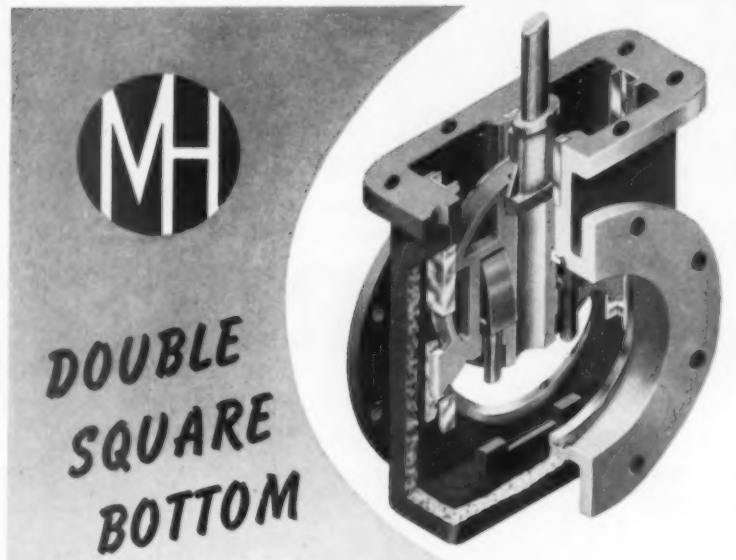
Electronic Brain Control Systems

805

The Sparks-Withington Co., Jackson, Mich., has announced a new method by which industry can select from a series of 21 standard "building block" components the best electronic control system to regulate push-button operations from remote points.

According to the company, this new method is already in use in the oil industry, in petrochemical plants, and in municipal water pumping systems providing a "brain" and a "nervous system" to control vital production operations.

Five standard control systems are now available utilizing the modular units: (1) automatic alarms; (2) remote metering; (3) descreet control; (4) proportional control; and (5) transmission systems. The are all complete, integrated systems with all needed components supplied, and installations can be made by any plant electrician. The systems will function over telegraph and carrier circuits and co-axial cable; and to span long distances or difficult terrain, radio and VHF, UHF, and micro-wave circuits can be used.



GATE VALVES

When it is desired to install a gate valve for throttling purposes, or in a vertical pipe line, M & H double square bottom valves have many important advantages.

When valve is opened, each of the three shoes on both discs immediately contact the feathered edge of the tracks. These three contacts result in the disc being eased away instantly from the seat. The shoes then ride the tracks squarely and firmly for the full travel of the disc. In closing, discs ride the tracks down to a point exactly opposite the valve seat. At that point, the discs are clear and free to seat by action of the two spreaders, each functioning independently of the other. The tracks are stainless steel channels and the two side shoes are bronze-faced.

M & H double square bottom valve prevents the down stream gate from tilting into the down stream port opening and by chatter or vibration damaging the seat and gate rings. These valves can be installed with either disc on the down stream side.

M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA

M&H PRODUCTS

FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Back Hoe-Backfill Blade Combination

806

The Wain-Roy Corporation, Hubbardston, Mass., has recently announced the manufacture of a combination back-hoe and backfill blade attachment for the International 300 tractor. The handy, low-cost combination is engineered to handle an amazing number of different trenching jobs, bell hole and foundation excavation, plus backfilling, leveling, grading, etc.

Both attachments are attached to a husky sub-frame, providing a sturdy mounting which, together with self-leveling hydraulic stabilizers, relieves the tractor itself of heavy loads.

The hoe is a complete, self-contained unit and can be removed or attached in less than 30 minutes. Only four pins and two hoses need be attached before it is ready for operation.

The effective digging depth of the hoe is 11 feet and, because it is able to dig and dump in a 190 degree radius, the hoe may be worked in extremely cramped quarters, reducing interference from passing traffic.

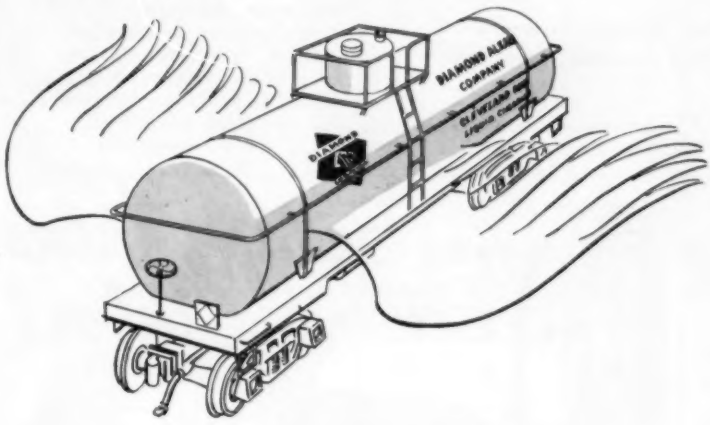
pH Meter Tester

807

Photovolt Corporation, New York, N. Y., has developed an electronic tester designed for quick and easy checking of the proper performance of pH meters, without requiring either electrodes or buffers. With the aid of the tester, it is possible to make sure, within a minute or two, whether difficulties encountered in pH tests are traceable to the instrument proper or to anything outside the instrument such as electrodes, buffers, or procedure.

CHEMICALS YOU LIVE BY

Diamond Chlorine



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When you want chlorine or technical co-operation in a hurry, call DIAMOND ALKALI.

We are equipped to give you fast deliveries from five conveniently located plants; technical help from one of the world's greatest stores of chlorine know-how.

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DIAMOND ALKALI's years of know-how have been compressed into this chlorine safe-handling wall chart. Hang it where workers can read it. Copies free. Ask your DIAMOND sales office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

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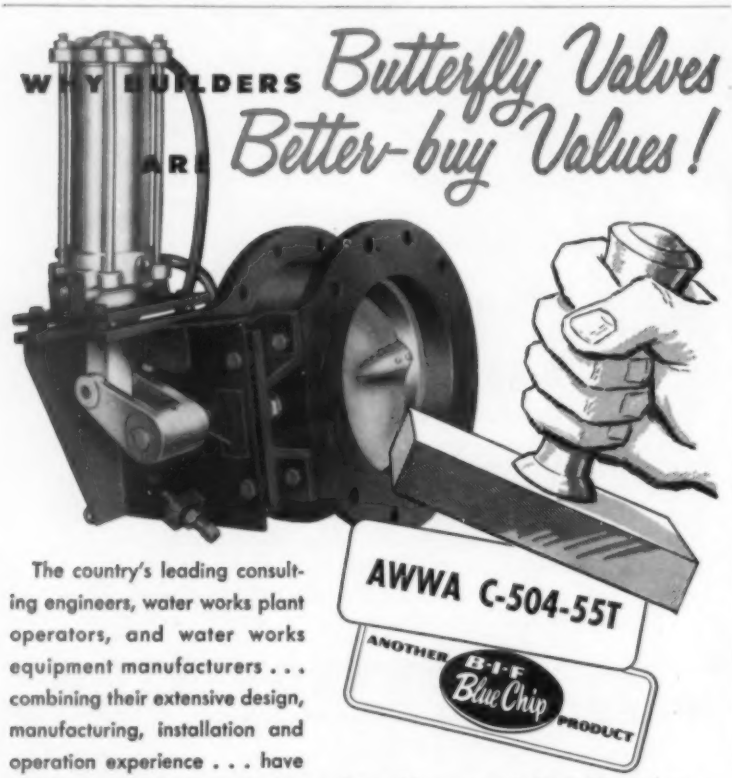
The tester operates directly from the AC power line. It is compact and convenient in handling. A carrying case is available so as to make it easy to take the tester along on service calls and to check pH meters on location, without taking them to the service quarters.

New Primer Assures Vinyl Coating Adhesion

808

The Garland Co., Cleveland, Ohio, has developed a new "intermediate" primer which insures positive bond for finish coats of corrosion-resistant vinyl-resin paints.

Vinyl-based coatings, while highly resistant to acids, alkalis and other chemicals, are notable for poor adhesion, particularly when the surface covered is chemically at variance with the vinyl resins in the paint. To overcome this tendency a secondary coat of Acanal intermediate primer, painted over an initial wash primer coat, is said to provide a compatible base for the finish coat.



The country's leading consulting engineers, water works plant operators, and water works equipment manufacturers . . . combining their extensive design, manufacturing, installation and operation experience . . . have prepared exacting specifications for rubber-seated Butterfly Valves. **BUILDERS-PROVIDENCE** Butterfly Valves conform to these specifications and offer the following superior features:

- √ Extra-rugged body construction.
- √ Extra large diameter, stainless steel shafts.
- √ Heavier, larger, longer bearings reduce unit bearing load.
- √ Heavier, sturdier vanes.
- √ Operators matched to valve . . . to meet job torque requirements and *minimum* AWWA Specs.

Builders Butterfly Valves fully comply with AWWA STANDARDS to make them BETTER-BUY VALUES. Request Bulletin 650-L1. Write to BUILDERS-PROVIDENCE, INC., 350 Harris Ave., Providence 1, R. I. . . . division of

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PROVIDENCE, RHODE ISLAND
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BUILDERS-PROVIDENCE, INC. • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

Pipe Leak Locator

809

The Goldak Company, Inc., Glendale, Calif., has announced the availability of the Model L-46 Senior Leak Detector, that makes possible savings in time and labor in locating known water leaks.

The L-46 features a high-gain circuit sensitive through a filter

system to the range of frequencies occurring in the average leak. The detection head is a full two inch square crystal encased in sponge rubber. The output is used to drive a 3 inch microammeter and an audio indication is produced in a pair of crystal earphones. It is completely self-contained and uses standard portable batteries and miniature tubes. Included are attachments so that the microphone can be used to make readings though dirt, concrete, pavement or on valves, risers, shut-offs, etc.

Underground Pumping Station

810

Schmieg Industries, Center Line, Michigan, is now offering an improved package underground pumping station for use in conjunction with handling municipal sewerage and highway drainage problems.

The company has claimed many improvements over existing underground pumping stations relative to efficiency, easier maintenance and greater durability. Schmieg's design has been reviewed by over 20 state chief sanitary engineers, in addition to being approved by design and consulting engineers.

Mono-Column Demineralizer

811

The Penfield Manufacturing Co., Inc., Meriden, Conn., has devel-

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Equipment — Products
Information — Literature

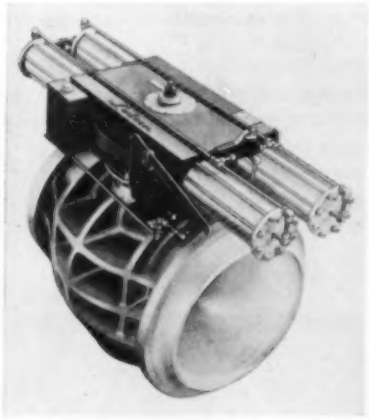
oped a new Penfield MA-500 unit, which operates on the mixed bed principle, and produces up to 500 GPH of super high purity water at a cost of only a few cents per 1,000 gals.

All operating functions, including the regeneration cycle, are fully automatic. When the effluent's conductivity (purity) falls below the desired pre-set standard, the unit automatically stops and the need for a regeneration cycle is signalled by a red light.

Turning one switch then actuates the regeneration cycle which completes itself entirely automatically, including rinsing and recutting-in the effluent when desired resistivity is reached. One regenerant tank only is supplied; this is for the caustic solution. Acid draw-up is directly from container. Proper dilution of the acid is accomplished by a special Penfield eductor.

High-Pressure Plug and Ball Valve Operator

812



Ledeen Manufacturing Co., Los Angeles, Calif., has introduced the Ledeen Quad Actuator, that was built to operate high-pressure plug and ball valves up to 36 inches in size.

Features claimed for the new actuator are: balanced torque delivered to valve stem through four-cylinder operation; gas and oil systems entirely separate. No gas-oil interface; for periodic testing, detachable lever permits operation of actuator and controls without turning main valve; easy field installation without modification of plug valve; available in wide range of torque capacities, with a variety of control systems.

how to

CUT CORROSION LOSSES

a report by Koppers Company, Inc.

Russell C. Stromquist
Corrosion Consultant

Recently, we were asked to recommend protective coatings in a plant on the West Coast. In analyzing their coating and enamel needs, we did our usual survey of the installation. After the survey, the customer's Chief Engineer remarked, "You fellows certainly go to a lot of trouble just to tell us what coating system we should use."

We do—because we know it is good for our customers and, therefore, good for us. Case history records prove clearly that careful study *before* making recommendations insures a better protective coating job at lower annual cost. In analyzing protective coating needs, our corrosion engineers follow a "pre-coating check list" based on experience on thousands of jobs.

* * *

The first step in the pre-application survey is a study of the environment. Specifically, you should always take into account the corrosive atmosphere: such factors as acid fumes, intense sunlight, salt air, etc. Physical environment—exposure to abrasion or impact—also plays an important part in the selection of an effective coating system.

The extent of temperature variation and expected minimum-maximum temperatures are important considerations, since the coating chosen must (a) resist low-temperature embrittlement, (b) resist high-temperature flow and (c) harden properly at service temperature.

The moisture environment too, is important in selecting protective coatings. Besides necessary water resistance, the coating should stand-up under pronounced wet-dry cycles.

A thorough cost analysis is a vital part of any pre-coating survey. Many factors are involved, varying in importance with the specific application. For example, total coating cost—made up of surface preparation and application costs—must be balanced against the cost of periodic maintenance. In some cases, the coated surfaces will not be accessible and coating-life will be a *direct* measure of the life of the material.

The cost of probable shut-down or loss of production time is perhaps one of the most important evaluations that must be made in intelligent selection of corrosion-preventing coating systems. Often, it outweighs the direct replacement costs of materials to be protected.

* * *

This pre-coating check list, detailing the protection required and under what circumstances, is a key factor in the exceptional performance of Bitumastic® coatings. Such thoroughness sometimes leads us to willingly recommend some material other than one of Koppers eleven basic Bitumastic coatings to solve a customer's problems.

* * *

In the next report, we will discuss why surface preparation is so vital to the life and economy of any protective coating. Meanwhile, we'd like to hear about your corrosion problems. Koppers Company, Inc., 1300 Koppers Bldg., Dept. 109H, Pittsburgh 19, Pa. District Offices: Boston, Chicago, Los Angeles, New York, Pittsburgh and Woodward, Ala.

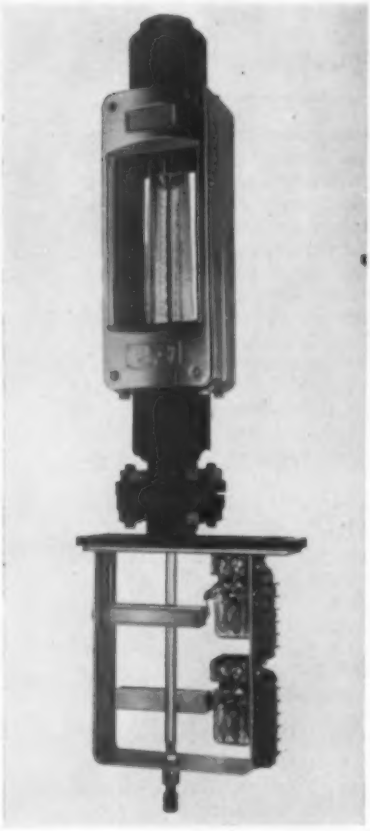
KOPPERS

BITUMASTIC
REG. U. S. PAT. OFF.
COATINGS AND ENAMELS

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Vibration-Proof Flow Alarm

B13



Fischer & Porter Co., Hatboro, Pa., has developed a flow alarm that combines low cost with vibration-proof operation.

Known as the F & P Ratolarm, it uses two snap-action electrical contacts, hermetically sealed in a glass tube, which are drawn together to set off the alarm by passage of a magnetic float extension rod.

The switch can be positioned in the mounting frame either above or below the magnet in the float extension rod to give a signal for either high or low limits of flow. If placed above the magnet, it will set off the alarm when increasing flow causes the magnet to rise to a pre-determined position. If placed below the magnet, it sets off the alarm when the flow falls below the desired rate or fails entirely. One switch can be set above and another below the magnet to give high and low alarms. Multiple alarms may be incorporated for special applications.

Chlorine Vaporizer

B14

The Whitlock Manufacturing Co., West Hartford, Conn., has available the Whitlock Chlorine Vaporizer system that provides high capacity output at low equipment cost.

The vaporizing chamber is a multi-pass steam-jacketed vessel carefully designed to produce dry gas, the outer steam jacket having ample surface to effect the necessary vaporization. A properly located inner baffle distributes the incoming liquid chlorine about the walls of the lower steam jacket and inner heating chamber. The chlorine chamber is designed for a pressure of 150 psig ,and the steam chamber for 30 psig.

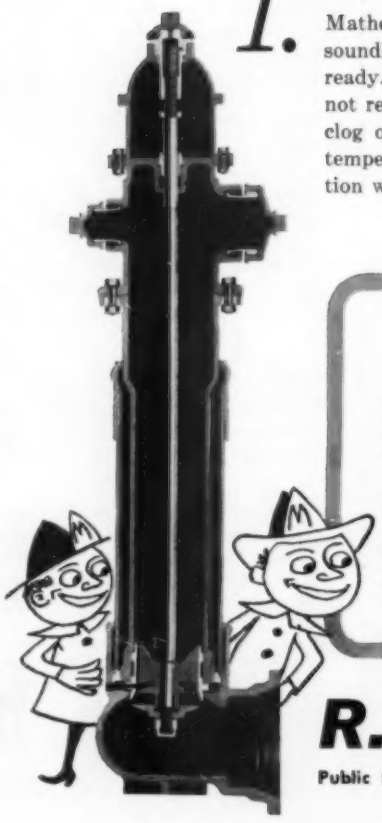
A complete unit, the vaporizer system permits almost immediate operation—it is only necessary to connect steam, condensate, chlorine and vent lines, and to insulate when required. The controls have been carefully selected for minimum cost consistent with safety and ease of operation.

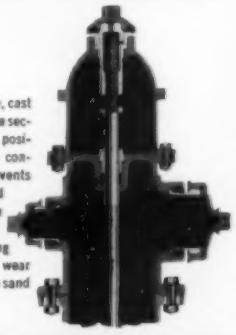
SPECIFY MATHEWS FOR

You need ask two questions

1. **Will they be ready for instant use in an emergency?**

Mathews Hydrants are so simply and soundly constructed that they are always ready. Water, ice and sandy deposits cannot reach key parts to rust or freeze, or clog operation. In any weather and all temperatures, Mathews Hydrants function with a minimum of maintenance.





Stuffing box plate, cast integral with nozzle section, provides a positively leakproof construction. It prevents any water or sand from reaching the operating thread. No rusting, freezing or clogging. No wear on thread through sand abrasion.

R. D. WOOD

Public Ledger Building, Independence Square
Philadelphia 5, Pa.

Non Fish-Killing Algaecide-Fungicide

815

Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y., has announced that after four years of country-wide testing their fungicide Phygon-XL, that it has been supplying to fruit and vegetable growers, is also an effective and economical algicide.

The chemical is capable of holding down the growth, or killing, several types of algae and also some water weeds. If used when water temperatures are above 65°F, and according to recommendations, it will not harm fish.

Relatively small amounts of Phygon-XL are needed to keep algae growth down. Blue-green algae can be controlled with ½ to 1 pound of the chemical for each acre of pond surface. On green algae 4 to 5 pounds are used per acre. Water milfoil, a submersed weed, requires 15 pounds per acre, and in this case only half the pond should be treated at one time.

Phygon-XL is a yellowish powder that will mix readily with water. It can be mixed with water then sprayed on the pond surface.

Leopold Introduces Butterfly Valve

816

The F. B. Leopold Co., Inc., Pittsburgh, Pa., has added rubber seated butterfly valves to its line of equipment.

In the Leopold design, the valve seat is of resilient neoprene rubber or pure gum rubber, vulcanized around a continuous steel ring insert. There is no break in this steel ring, thus eliminating any abnormal wearing. In addition, this exclusive feature increases the firmness of the valve seat for longer life and provides rigidity for easier installation.

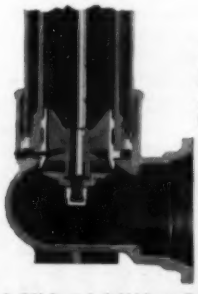
There are other important advantages offered by the Leopold Butterfly Valve. The disc is edge coated with stainless steel, monel or other specified alloy and then finely machined to a smooth beveled edge. To prevent disc overtravel, the unit is equipped with mechanical stops for manual operation. For automatic operation the stops are incorporated in the operator itself. A single retaining ring is provided to hold the valve seat firmly in place in the center section of the valve body.

Leopold Rubber Seated Butterfly Valves are made in sizes 6" to 72", of any desired metal, to conform to AWWA specifications and to meet a wide range of operating requirements.

DEPENDABLE PROTECTION
only
about fire hydrants:

2. Can the hydrant be quickly replaced if broken in a traffic accident?

When you have Mathews Hydrants on the job, neighborhood fire protection can suffer only momentary interruption. A broken Mathews Hydrant can be replaced with a new barrel in less than half an hour, and *without excavating.*



Main valve, true compression type, opens against and closes with water pressure. The higher the pressure, the tighter the valve. When hydrant is broken in traffic accident, there's no leakage with consequent dangerous loss of pressure.

Available for mechanical joint connections

COMPANY

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

W & SW

Manufacturer's News

New Multi-million Dollar W-K-M Plant Dedicated

A. C. F. Subsidiary 12-Acre Plant Located at Missouri City, Texas

The new multi-million dollar plant of W-K-M Manufacturing Company, Inc. at Missouri City, Texas, was dedicated on Thursday, May 17, in a significant ceremony. Taking part in the ceremony were J. S. Downs, President of W-K-M, C. J. Hardy, Jr., Chairman of the Board of ACF Industries, Inc., (of which W-K-M is a subsidiary), The Honorable Ben Ramsey, Lieutenant Governor of the State of Texas, Ben C. Belt, President of the Houston Chamber of Commerce, The Honorable R. A. Stallings, Mayor of Missouri City, Texas, and John Hampton, the district representative of the International Association of Machinists, and the Reverend James T. Garrett.

An invocation by Mr. Garrett opened the program. J. S. Downs W-K-M president, made a short talk reviewing the history of W-K-M which he has served for 20

Taking part in the dedication ceremony were (l to r): John C. Hampton, dist. rep. of the International Association of Machinists; J. S. Downs, president of W-K-M Manufacturing Co.; The Honorable Ben Ramsey, Lieut.-Governor of the State of Texas; Ben C. Belt, president of the Houston Chamber of Commerce; C. J. Hardy, Jr., Chairman of the Board of ACF Industries, of which W-K-M is a subsidiary; R. A. Stallings, Mayor of Missouri City, Texas, The Reverend James T. Garrett, and C. Allan Fee, Vice President and Secretary of ACF Industries.

INTEGRITY COUNTS in PUMPS, Too

This DISTINGUISHED PUMP will win your RESPECT
TYPE OJ
AURORA® Horizontally Split Case, Double Suction, Single Stage Centrifugal Pump
For general water supply for municipalities, industries, office buildings, institutions—also—for handling liquids, chemical solutions, oils etc., in a wide variety of industries. Write for Bulletin 105-BM for further details.
AURORA Always PUMPS

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AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY

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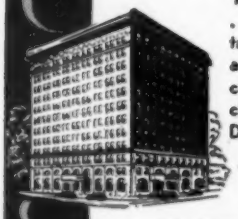
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

Tops in Everything

CONVENIENT

Member Diners' Club



Ideally located in St. Louis, two short blocks from the Union Station and in the center of the Wholesale District . . . Preferred, always by experienced travelers because of its outstanding advantages— Every room with combination tub and shower . . . and circulating ice water. Delicious food . . . cheerful service.

AIR-CONDITIONED ROOMS

350 rooms from $3.50

HOTEL LARIDGE

ERNIE SIMONS General Manager

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Free Parking

ST. LOUIS

years. Lieut. Governor Ramsey made the principal address pointing out the tremendous industrial growth that Texas, has made in the past few years and attributing it to the fact that labor, government, community and industrial leaders have worked together for real industrial progress.

Mr. C. J. Hardy, Jr., ACF Chairman, made a short speech highlighting the great future ahead for the new W-K-M organization and closed by dedicating the plant to the men and women who make up the work force of the plant, with the final comment, "may they work and earn here, each according to his abilities and desires, for that is the American way".

The actual opening ceremony which followed was based on the theme of the program—that labor, government, community and industrial leaders and groups must work together for real progress and prosperity. Mr. Ben C. Belt (Houston Chamber of Commerce) highlighted this theme as he explained the procedure to the men on the speaker's platform. John C. Hampton represented labor and pulled an electrical switch; R. A. Stallings represented the community and he pulled a switch; The Honorable Ben Ramsey also pulled a switch as a representative of government, and finally J. S. Downs pulled the last electrical switch as a representative of industry. As the final switch was pulled it set off a large aerial bomb and a pyrotechnic display which spelled out the word Progress in fire.

Witnessing this impressive ceremony on a cloudless Texas afternoon were the some 1000 employees of the W-K-M plant and a group of almost a thousand visitors made up of W-K-M's customers and suppliers as well as the business and government leaders of the area.

Wallace & Tiernan Occupies New Office and Warehouse

Wallace and Tiernan Incorporated, Belleville, N. J., has announced the removal of its Dallas, Texas office to new quarters at 5610 Dyer Street, Dallas. The office occupies an entire building, with provisions for warehouse space.

A complete line of Wallace & Tiernan equipment and parts will be stocked in Dallas. Mr. F. H. Puck-

(*Continued on page* 104*A*)

and sewage in . . .

with Ropax®

non-porous joint packing

When ground water seeps through your sewer pipe joints, it can result in an overtaxed system, needless expense and labor.

ROPAX is a non-porous, adhesive joint packing designed to minimize this problem. It compresses and conforms snugly to the contour of the pipe bell, forming a solid seal against water passage.

KALKTITE®, Presstite's service-proved, cold-applied asphaltic joint cement, then forms a dense, tough, flexible seal that cuts infiltration to a minimum. It sets up internally, unaffected by hot, cold, wet or dry conditions.

WRITE for PRESSTITE CATALOG, describing 3-Step Sewer Joint Sealing System (including Presstite High-Bond PRIMER).

PRESSTITE Sealing Compounds

PRESSTITE-KEYSTONE ENGINEERING PRODUCTS COMPANY

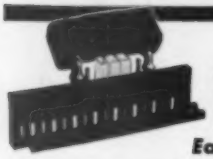
K A P

A Division of AMERICAN-MARIETTA COMPANY

3700 CHOUTEAU AVENUE, ST. LOUIS 10, MISSOURI • 101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

TAYLOR COMPARATORS

give accurate pH, CHLORINE TESTS



COMPLETE, COMPACT KIT— *Easy To Use*

Exact determinations of pH or chlorine content can be made in a matter of minutes with Taylor Comparators. Easy-to-use Taylor Comparators require no additional equipment or chemicals. Everything necessary to make tests comes with each comparator. Compact carrying case also available. No experience or technical knowledge needed. Simply fill the three tubes with the sample, add reagent to center tube, move color standard slide across until colors match and read value direct from slide. Fluoride Comparators available.

COLOR STANDARDS GUARANTEED

Taylor Liquid color standards carry an unlimited guarantee against fading . . . no danger of mechanical inaccuracy.

SEE YOUR DEALER, or write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes all Taylor sets.

W. A. TAYLOR AND CO.
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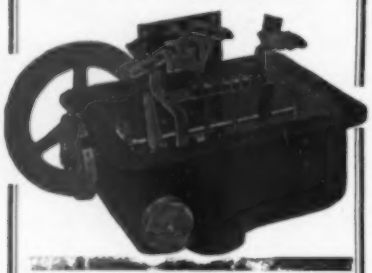
ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 Hampden Ave., St. Paul 4, Minn.

haber, Division Manager, advises that the new office and warehouse space will permit prompt shipments of material to Wallace and Tiernan customers in the states of Texas, New Mexico, Oklahoma, Arkansas and Louisiana.

Wilcox Heads New Valve Division Of S. Morgan Smith

S. Morgan Smith Company, York, Pa., has announced the creation of a new Valve Division to handle all valve manufacturing and marketing operations.

Burwell B. Smith, Vice President in Charge of Sales and Engineering, announced the new division will contain its own sales, engineering and manufacturing departments. It will be responsible for the entire SMS line of Rotovalves, Butterfly and Ball Valves.

The new division will be headed by Carl J. Wilcox, who has been with the S. Morgan Smith Company since June, 1941. Prior to accepting his new assignment, Mr. Wilcox had been manager of Valve Sales. Engineering, manufacturing and valve sales operations will all report directly to him.

Chicago Bridge To Build Plant In Delaware

Chicago Bridge & Iron Company, Chicago, Illinois, has announced that a steel fabricating plant will be built at New Castle, Delaware. The plant will supplement the activities of the firm's plant in Greenville, Pennsylvania, in serving the Middle-Atlantic Seaboard.

Present plans call for the installation of a single fabricating building and an outside crane runway for handling and storage of materials. Site preparation and installation of foundations will be started this summer. It is expected the plant will be completed in approximately one year.

with **"GUNITE"**

PRESSURE CONCRETE CO.

gives cement greater utility, versatility!

FOR REPAIRING: Reservoirs, Dams, Filter Plants, Sewage Disposal Plants, Tanks, Stadiums, Bridges, Sea Walls, Breakwaters.

FOR LINING: Reservoirs, Swimming Pools, Tunnels, Sewers, Pipe, Concrete, Brick and Steel Tanks, Stacks, Bunkers, Irrigation Ditches.

FOR CONSTRUCTING: New Tanks, Stacks, Piles, Sidewalls and Roofs, Steel Encasements.

Write for 48-page illustrated booklet showing "GUNITE" at work.

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The Heart of fine WATER PURIFICATION SYSTEMS

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

Roberts Mechanical Equipment

ROBERTS FILTER Mfg. Co.
607 COLUMBIA AVE.
DARBY, PA.

Byron Jackson Pump Names New Regional Managers

Byron Jackson Pumps, Inc., Division of Borg-Warner Corporation, has announced two new regional manager appointments.

Don Metz, who has headed the Mid-West sales territory (headquartered in Chicago) will return to his former post of San Francisco regional manager. E. R. Raguse has been named regional manager in the Chicago office. Raguse formerly was Byron Jackson Pump district manager in Tulsa, Oklahoma.

Kennedy Valve Promotes Erven

Kennedy Valve Mfg. Co. Elmira, N. Y. has announced that Mr. James R. Erven, previously Branch Manager of the New York Office has been named Vice President and Sales Manager.

Mr Erven joined Kennedy Valve in 1950 as a salesman in the New Orleans office and was moved to his recent post in New York in 1952. He previously was purchasing agent of the Calmes Engineering Co., in New Orleans, builders of ships and barges.

Multi-Amp Corporation Moves To Union, N. J.

Multi-Amp Corp., Union, N. J., has announced the removal of its plant and offices from Newark, N.J. to 465 Lehigh Avenue, Union, N. J.

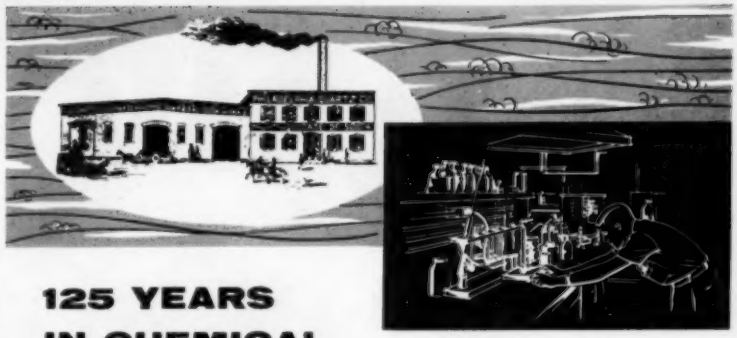
The new facility, designed specifically to meet the expanding needs of Multi-Amp's highly specialized operation, is located in the New York, New Jersey metropolitan area convenient to major highways and transportation centers. Accessibility to markets and opportunity for this future expansion in a non-congested area were the reasons for the move.

Infilco Promotes J. M. Young and Lee Hiser

Infilco Inc., Tucson, Arizona, has announced .that Mr. Joseph M. Young, formerly Field Sales Engineer in the Southwest area, has been transferred to headquarters of the Ion-Exchange Department of the company.

Mr. Young's appointment follows closely the formation of a special Ion-Exchange Department to take care of the ever increasing demand for this type of water treating equipment.

(*Continued on page* 106*A*)



125 YEARS IN CHEMICAL SERVICE . . . SOAP TO SILICATES

Soap, our first product in 1831, was followed 25 years later by silicate of soda used in soaps. Silicates became our exclusive interest in 1904.

PQ research in silicate properties through the years has uncovered and developed new uses; for example, raw and waste water treatment. We introduced several new methods of reacting silicates to produce activated silica sol used as coagulant aids.

Results of these studies have been published and are available to you.

Let us know how we can help you.

TRADEMARKS REG. U.S. PAT. OFF.

1831-1956 125th ANNIVERSARY

PQ SOLUBLE SILICATES / N-SOL PROCESSES

PHILADELPHIA QUARTZ COMPANY

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Nine Plants Distributors in 70 Cities

flow information at your finger tip!

"OLD FAITHFUL"

SPARLING MAIN-LINE WATER METERS have long been a standard of engineers and superintendents seeking the finest equipment at a moderate price.

Request information from any SPARLING OFFICE.

- MAIN-LINE METERS
- FLOW and CHEMICAL FEED CONTROLS
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SPARLING METER COMPANY

Incorporated

225 NORTH TEMPLE CITY BLVD., EL MONTE, CALIF.

ATLANTA 3	66 Luckie Street NW	945 North Main St.	LOS ANGELES
BOSTON 8	6 Beacon Street	650 First Avenue West	ROSELLE, N. J.
CHICAGO 8	1500 South Western Ave.	85 Industrial St.	SAN FRANCISCO 24
CINCINNATI 2	626 Broadway	1932 First Avenue	SEATTLE 1
DALLAS 1	505 No. Ervay St.	207 Queens Quay West	TORONTO, CAN.
KANSAS CITY 6, MO.	6 E. Eleventh St.	248 London Rd.	ROMFORD, ENGLAND

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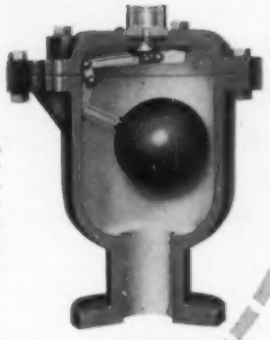
PRESSURE AIR VALVES

***Best* insurance**
against pipeline blowouts

Crispin Pressure Air Valves allow air to escape automatically while line is under pressure while no air accumulates to obstruct water in pipelines. Sturdy, simplified construction for the best in service. One of several Multiplex Air Valves that are preferred by water works engineers for dependable and efficient control of air in pipelines.



AIR CONTROL VALVES FOR OVER 40 YEARS

multiplex
MANUFACTURING COMPANY
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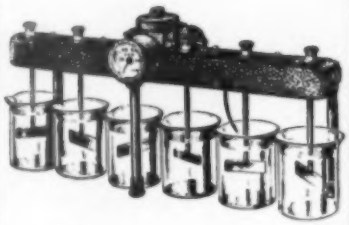
FREE CATALOG . . .
Write for a copy of the fact-full Crispin Air Valve Catalog which includes illustrations, complete specifications and lists the satisfied users throughout the world.

P & B Multiple Stirrer



When several samples are mixed simultaneously under identical conditions the optimum concentration of flocculent may be quickly selected and translated to plant quantities . . . The mixer takes 1,000 ml. beakers. Speeds from 15 to 100 r.p.m. are standard.

Write: **Cat. No. 77-700**

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

Mr. Lee Hiser, formerly in the engineering department in Tucson, has been appointed Field Sales Engineer for the Southwest territory in place of Mr. Young. His headquarters will be in Houston, Texas.

Dorr-Oliver Expands Hazelton Plant

Dorr-Oliver Inc., Stamford, Conn., has announced a $900,000 expansion program for their manufacturing plant at Hazelton, Pa. Greatly enlarged fabricating facilities will enable Dorr-Oliver to produce, at its own plant, structural parts which have been sub-contracted to outside firms in the past.

Erection of two new buildings totaling 30,000 sq. ft. will bring the Hazelton plant floor space to roughly 125,000 sq. ft. A major portion of the new floor space will be devoted to expansion of the fabricating section and additional storeroom space. The new facilities are expected to be in operation by the end of the year.

Neptune Meter Names New Sales Representatives

Neptune Meter Co., New York, N. Y., has announced the appointment of three new sales representatives.

Mr. John Paul McCullough, of Corinth, Miss., has been named manager of the company's Atlanta branch office. He will handle the distribution of water meters in the States of North and South Carolina.

Mr. Hood van den Arend, Jr., of Flourtown, Pa., and Mr. Joseph R. Vetromile, of Pittsburgh, have been assigned to the Philadelphia branch office. Mr. van den Arend, Jr., will cover Eastern Pennsylvania and Mr. Vetromile will handle the Western half of the State.

W-K-M Mfg. Co. Opens New Plant

W-K-M Manufacturing Company, Houston, Texas has announced the opening of a new 12-acre multi-million dollar air conditioned plant occupying a 75-acre site at Missouri City, west of Houston.

W-K-M Manufacturing Company, a subsidiary of ACF Industries, Inc., is itself a combination of W-K-M Manufacturing Company, Inc., Houston; The Key Company, East St. Louis; and the ACF Valve Division, Detroit. All activities of the three concerns are now concentrated in the new facilities on U. S. Highway 90-A and on the main line of the Southern Pacific Lines.

Although the three are under one roof, the plant is so designed that each product group has its own individual production lines.

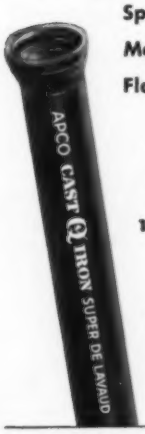
Machinery from the former W-K-M plant in Houston, from the Key plant and from the Detroit plant has been set up along with the new equipment essential to the expanded operation under the consolidated operation.

Personnel of the two out-of-state plants has been transferred to the Houston area, so that the previous high standards of operation can be maintained without interruption. J. S. Downs, President of W-K-M Manufacturing Company, will continue to head the expanded organization.

TESTING!

✔ Chemical Test
✔ Sand Compression Test
✔ Wall Thickness Test
✔ Rockwell Hardness Test
✔ Talbot Strip Test
✔ Pipe Ring Compression Test
✔ Internal Pressure Bursting Test
✔ External Impact Test

Some, but not all, of the many tests we make to assure you more long years of trouble-free service with Alabama's Super De Lavaud Cast Iron Pipe. Sizes of 3" to 24" in modern long lengths. Bell and Spigot, Roll-on-Joint, Mechanical Joint, and Flanged.



We invite inquiries to our nearest sales office—

122 So. Michigan Avenue
Chicago 3, Ill.

350 Fifth Avenue
New York 1, New York

General Sales Offices.

ALABAMA PIPE COMPANY

ANNISTON, ALABAMA

W&SW

New Literature

Water Well Systems

B17

Layne & Bowler, Inc., Memphis, Tennessee, has published a bulletin on **Layne Water Well Systems.**

This bulletin not only covers Layne water well systems, but such subjects as Layne oil and water lubricated Vertical Turbine Pumps, special water well drilling, service work, shutter screens, irrigation wells and pumps, water and well treatment for rehabilitating water sources and other phases of water development for industry and municipalities.

Prestressed Concrete Tanks

B18

The Preload Company, Inc., has just published a technical bulletin on **Preload Concrete Tanks For Water and Sewage.**

The bulletin describes the current trends in the design and construction of prestressed concrete tanks including illustrations of typical tanks and standpipes.

Remote Electrical Transmission System

B19

Simplex Valve & Meter Co., Lancaster, Pa., has just published a bulletin on the **Orthoflow,** a system for the accurate and rapid transmission of metering data from one location to another.

Graphically illustrated, this well-documented 16-page bulletin describes the versatility of the system for transmission of flow data, liquid level data, or pressure measurement data. It contains diagrams of each type of application in addition to dimensional drawings and capacity charts.

Bar Screening In Waste Treatment

B20

Chain Belt Company, Milwaukee, Wis., has published a bulletin on low cost bar screening installations and operation.

Details of a **Front-Cleaning** design, photos of actual installations, and mechanical features are included.

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Cam-Seald Plug-Valves

821

Homestead Valve Manufacturing Co., Coraopolis, Pa., has available a 20-page reference book on Homestead **Cam-Seald Plug-Valves.**

An exploded-view drawing with descriptive text explains the construction and operating features of the valve. Complete dimensions, typical uses and a photograph of each valve provides a fast and easy reference to the selection of the proper valve. Repair parts and recommended lubricants are also given. A page of actual installation photographs complete the book.

Gearmotors

822

U. S. Electrical Motors, Los Angeles, Calif., has published a bulletin featuring the latest design improvements in **Gearmotors** and embodying 60 interesting illustrations in multicolor.

This 16-page bulletin shows comparative advantages of gearmotors, lists ratings from ¼ to 30 horsepower with gear ratios as high as 10:1. Cross sectional details of the motors and enlargements of outstanding features are dramatically displayed, with particular emphasis to the principle of solid shank pinions, integral oil seal and methods of cutting gears specifically for Syncrogear motors.

Back Cleaned Bar Screen

823

Walker Process Equipment Inc., Aurora, Illinois, has published a bulletin describing the **Back Cleaned Bar Screen** for sewage plants and industrial waste treatment installations.

The 12 page, two color bulletin includes a discussion of the application of screens, design data, a complete description of the Walker Process screen and suggested specifications. Drawings and pictures illustrate the unit in detail.

Ditcher Catalog

824

Gar Wood Industries, Inc., Wayne, Mich., has just released a new, 16-page catalog covering the recently introduced Gar Wood-Buckeye 305, 307 and 308 **Pipeline and Utility Ditchers.**

The new catalog is profusely illustrated throughout, and describes a number of new engineering developments, including the Gar Wood-Buckeye hydraulic conveyor drive, live hydraulic wheel hoist controls, specially designed traction and digging transmissions and dozens of other new features incorporated in the Buckeye 305, 307 and 308 models.

Activated Sludge Plants

825

Infilco Inc., Tucson, Arizona, has just published a bulletin that presents a comparison of different designs used in **Activated Sludge Plants** for the treatment of both domestic sewage and industrial wastes.

The essential requirements for an efficient oxidative biological treatment system are discussed. The advantages of the "Aero-Accelator" activated sludge plant for treatment of sewage and industrial wastes are set forth in detail. Operational comparison figures and diagrams, performance records and suggested plant layouts and specifications along with pictures of actual installation are also included.

Electrical Test Units

826

Multi-Amp Corporation, Newark, N. J., has available a set of data sheets describing the full line of **Multi-Amp Portable High Current Test Units** for safely checking and calibrating electrically actuated protective devices.

These data sheets contain up-to-date information on the recommended use, electrical ratings, component equipment and physical dimensions of the Multi-Amp units, together with illustrations of each standard model.

Swimming Pool Equipment

827

Graver Water Conditioning Co., New York, N. Y., has released a newly revised Bulletin on **Equipment For Swimming Pools.**

This 12-page well-illustrated brochure describes all of the component parts of the recirculation and purification system needed to

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Details of design for these components are discussed with the advantages and disadvantages being pointed out for the various modifications that are possible. A section is devoted to a comparison of pressure and diatomite filters with cut-away views of the internal structure of each being shown.

One section is devoted to sizes, dimensions, capacities and layouts of both diatomite and pressure systems. This section includes information on the actual selection of the filter size and accessory equipment sizes for given pool capacities, bathing load and water turnover. Plan and elevation layouts of a typical pool arrangement shows not only the recirculation system but also the piping arrangement and the placement of inlets, drains and outlets.

Odor Control Chemicals

828

Rhodia, Inc., New York, N. Y., has just published a 6-page brochure on the use of **"Almask"** odor control chemicals for the abatement of obnoxious malodors in municipal and industrial sewage and waste treatment plants.

The brochure deals with the use of "Alamask" for municipal waste treatment; municipal garbage disposal plants; industrial wastes and exhaust gases; effluents; exhaust stacks, ducts and water scrubbers, and its application in operating areas.

Water Testing Chemical Catalog

829

Hach Chemical Co., Ames, Iowa, has just published the **Hach Chemical Catalog For Water Testing.**

The catalog is divided into four convenient sections: 1, Procedure Section—Simplified procedures for water analysis are presented in alphabetical order: 2, Portable Tester Section—Information on new and improved types of Drop-Count testers; 3, Apparatus Section—This section comprises an expanded list of apparatus and glassware especially selected for water and sewage laboratories; and 4, Chemical Section—A complete list is given of chemicals and solutions for water testing, covering A.P.H.A. standard methods as well as the company's own procedures.

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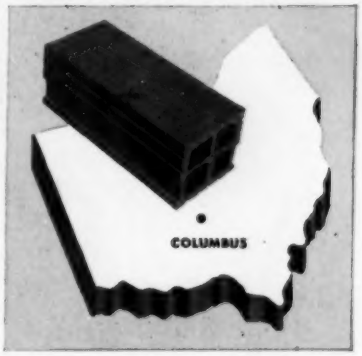

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There's a D-O Unit for Practically Every Step in Every Sewage Treatment Flowsheet

Aerial view of the Ada plant taken in 1954 shortly after starting up. Clariflocculator unit at left. Consulting Engineer: Ralph W. Delaney, Ada, Oklahoma.

DORRCO CLARIFLOCCULATOR

Used in New Ada, Oklahoma, Plant

LOW RATE TRICKLING FLOWSHEET

Typical of many U. S. cities, the problem of a steady growth of population in Ada, Oklahoma, resulted in badly overloaded sewage treatment plant facilities. By the late 1940's, it was apparent that the original plant built in 1939 was completely inadequate to handle the increased flow. Rather than expand existing facilities, studies made by the city indicated that it would be more economical to build an entirely new 3 MGD plant.

In designing the plant, Consulting Engineer Ralph W. Delaney of Ada, Oklahoma, incorporated a 70 ft. dia. Dorrco Clariflocculator mechanism in the flowsheet to handle the flocculation and clarification steps. In addition to this combination unit, equipment at the Ada plant includes a Dorr Detritor unit for grit removal, a 168 ft. dia. Dorrco Distributor for low rate trickling filter treatment, a 75 ft. dia. Dorr Final Clarifier and a Dorr Mult-digestion System.

If you would like more information on Dorr-Oliver equipment and methods for modern sewage treatment, write to Dorr-Oliver Incorporated, Stamford, Conn., for Bulletin No. 6041.

Clariflocculator and Detritor T. M. Reg. U. S. Pat. Off.

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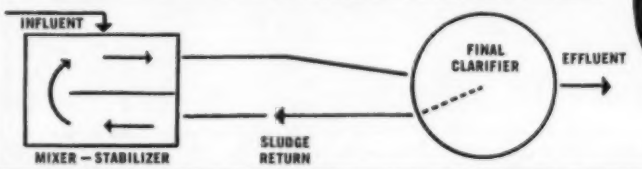
twice as fast in half the space

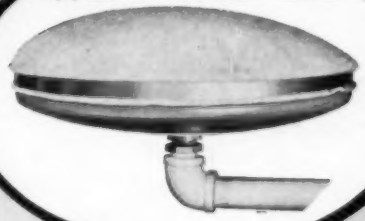
Sewage plant of Washington County Sewer Improvement District No. 1, at Bartlesville, Okla., is compact and efficient with INFILCO equipment.

Engineering by Wood & Craig Consulting Engineers, Tulsa, Okla.

FLOW DIAGRAM: DESIGN AVERAGE FLOW 0.39 M.G.D.



Equipment includes 80 COLAFLEX® diffusers.



Only 5 to 6 hours are required for throughput in the BIOSORPTION® high-rate activated-sludge treatment plant equipped by INFILCO—as compared to 10 to 12 hours for conventional equipment. Main components of the Bartlesville installation include a GRIDUCTOR® comminutor, a mixer-stabilizer with COLAFLEX® diffusers, WS clarifier and floating cover for digester. Overall results are excellent. Here are typical figures.

Period	Ave. Flow MGD	Average B.O.D. (p.p.m.) Raw Sewage	Final Effluent	% Removal	Suspended Solids (p.p.m.) Raw Sewage	Final Effluent	% Removal
1/14-2/3 '55	0.253	197	18	90.8	225	20	91.0

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